U. S. DEPARTMENT OF AGRICULTURE.

SECTION OF VEGETABLE PATHOLOGY.

QUARTERLY BULLETIN. DECEMBER, 1889.

Vol. 5. No. IV.

THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

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CHIEF OF THE SECTION.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1889.

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CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES.

(Plate XIII.)

By Franz von Tavel.

(*Continued from page* 123.)

IV.—Cucurbitaria Platani, *n. s.*

Among the numerous fungi which came under our observation during this investigation, we gave special attention to a *Cucurbitaria*. It was found only on the fallen *Platanus* branches and then sparingly, so that our investigations were necessarily limited to the formation of the pycnidia. For the same reason it was impossible to identify the fungus. It is here designated as *Cucurbitaria platani* n. s., because from a purely practical stand-point the object of an investigation must have a name, and because neither Saccardo nor Winter mention a *Cucurbitaria* growing upon *Platanus*.

The stroma of the fungus is circular and about 2 mm. in diameter. It lies under the bark, which becomes broken through by the perithecia and pycnidia. Generally several stromata stand close together. Twenty fruiting bodies, partly pycnidia and partly perithecia, stand in very irregular order upon a stroma. They are often very close to each other and frequently grow together. The pycnidia have very irregular cavities and thick, intensely black walls. The basidia are filiform, the pycnidia spores extraordinarily small, cylindrical, and colorless. The perithecia are flask-shaped but of very irregular form and without a distinct neck or papilla. Their walls are also black and scarcely project beyond the bark. The asci are 8-spored, cylindrical, obtuse above and suddenly tapering into a short pedicel below.

The spores are light brown at maturity, elliptical, a little smaller at the ends, and strongly constricted in the middle. They usually have six transverse septa, often more or less; the number of the longitudinal septa is very variable. They are 18–25 μ. long by 9–11 μ. broad (Fig. 13.)

The ascospores germinate rapidly even when they have been kept dry for a long time, but they behave very differently in water and in nutritive solutions. When sown in distilled water, sometimes all, and sometimes only single cells of the spore send out germ tubes which

grow rapidly for a long time. On account of the passage of the contents of the spore into the germ tube the former becomes much more transparent; its cells also swell up, but it shows no farther changes. The germ tube soon becomes divided up into short cells at its base. When the nutritive materials in the spore are used up the growth at the end ceases. The entire germ tube then divides up into roundish, much swollen cells, which produce gonidia-like buds.

The results are different when the sowings are made on gelatine which is mixed with a plum decoction, grape juice, or meat extract. The first phenomena of growth are the same. But the terminal growth of the germ tubes does not cease, and they consequently spread themselves over a relatively large area in a very short time. Their cells are therefore not short and thick but elongated, at first at least. In this case spores are not cut off.

The ascospore itself undergoes a considerable transformation. It swells up at first and becomes more transparent as happens when it is sown in water (Figs. 14–16). As the size increases new transverse septa and soon after longitudinal septa make their appearance. These septa become continually more numerous and consequently the whole spore increases in circumference; they appear in the greatest numbers in the central cells of the spore, while the ends change very little for some time. The primary cells may be visible for some time on account of the constrictions at the septa. In the manner described the spore is transformed into a large body easily visible to the naked eye and composed of a considerable number of very small cells, from which the germ tubes, which in the meantime have become large strong hyphæ, now project in different places. About six days after sowing it begins to turn brown and finally becomes so dark colored that further observations of special development are rendered impossible. It can only be seen that the cells composing the interior separate, leaving a cavity. After some time, during which the growth of the body has ceased, gonidia began to emerge from the opening in the apex. We have therefore a pycnidium situated in the center of a mycelium. A special pore which may be recognized by some especially large clear cells, is now started.

The formation of this pycnidium (it may be called a sporopycnidium in order to distinguish it from the others) does not occur when the spores are sown in distilled water; the germ tubes must therefore first grow at the expense of the spore and then take up nourishment from the substratum and carry it to the spore, in order to supply the consumption and furnish a surplus which makes it possible for it to attain such dimensions and pass through such transformations.

The sporopycnidium is a very interesting phenomenon for two reasons. In the first place it is known that by absorbing nutriment, a fungous spore may increase in dimensions and that its cells may divide De Bary (Morphol. u. Biol. d. Pilze, 1884, p. 123.) cites the *Mucorini* and

Sclerotineæ as examples of this. But such a luxuriant growth, connected with such a high degree of cell division, which simultaneously produces the growth of a mycelium from the spore, and changes the latter into a new and complicated organ of reproduction, can scarcely have been observed before.

But the case presents a further point of interest when compared with the formation of other pycnidia. We may discriminate between a symphyogenous and a meristogenous development. Pycnidia arise symphyogenously by an interweaving of hyphæ and meristogenously by the growth and division into cells of a piece of hypha in which the branches of the hypha may share. The sporopycnidium is therefore meristogenous even if it does not arise from a mycelial thread. It represents rather the most extreme case of meristogenous development, arising directly from the division and growth of the spore without the interposition of any foreign element.

Before the formation of this sporopycnidium is completed the beginnings of new pycnidia arise at the periphery of the mycelium. These are of meristogenous origin, yet several hyphæ are concerned in their construction. One or several cells swell up anywhere upon a hypha (Figs. 17–18), and these become divided by walls which are laid down both in transverse and longitudinal directions. In the vicinity of these spots the hyphæ which bound and those which accidentally cross or touch them exhibit the same changes, their cells also enlarging and dividing. In this way these hyphæ nearly fasten themselves to each other. Through continued growth and cell division there arises a many-celled compact body from which many hyphæ apparently originate; but it is from them that the body itself arose. The young pycnidia may attain considerable size without showing any cavity (Fig. 19). At first no differentiation can be seen until the walls of the superficial cells become thickened and brown. The single cells also increase in size with the growth of the whole, but the central portion finally falls behind the periphery, and the cells separate from each other in the center, without, however, as Bauke has shown for *Cucurbitaria elongata*, the process being begun by a very large definite cell. In this way there arises a cavity which enlarges with the growth of the pycnidium (Fig. 20) and is lined by uniform cells. From these grow out filiform basidia, which form a hymenium and cut off very small spores (Fig. 21). The outer wall of the pycnidium is now composed of cells whose contents have been transformed into a dark-colored mass, while the membranes themselves are less deeply colored. Here also are the beginnings of a special pore, as is the case in the sporopycnidium.

These pycnidia develop in essentially the same manner described by Bauke for *Cucurbitaria elongata;* but with this difference, that here the hyphæ which lie against the beginnings of the pycnidium do not merely form the envelope, but instead all the elements have the same functions, as is shown by cross-sections through quite young stages.

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The further development of *Cucurbitaria platani* was not followed out. Secondary pycnidia began to develop on the slide in extraordinarily large numbers. The mycelium gradually became transformed into a stroma, the hyphæ continually growing darker, more closely interwoven and smaller celled. A stroma of this kind was placed with the pycnidia upon a fresh *Platanus* branch upon a place where the bark was injured. The stroma soon became completely covered with pycnidia. The peripheral hyphæ penetrated the bark, from which only a few pycnidia followed. After a long time perithecia could also be seen; but they were so few that any investigations were not to be thought of.

The ascospores of *Cucurbitaria platani* were sown upon another branch. It remained intact for a long time, but after it was apparently dead and had begun to decay pycnidia broke out upon the cut surfaces and leaf scars, in short, wherever the bark was injured. It may be concluded from this that *Cucurbitaria platani* is not a parasite but merely a saprophyte. Cultures upon leaves gave no reliable results.

MYCOLOGICAL NOTES.

By George Massee.

(Plate XIV.)

1. Tremella tremelloides, (Berk.) Mass. (Fig. 1). Tremelloid; lobes fasciculate, *elongated*, *suberect*, almost free to the base or variously united, *compressed*, springing from a small contracted base, *surface scabrid*, dull orange; spores elliptic-oblong with a minute oblique apiculus at the base, 11-12 by 5 μ.

Sparassis tremelloides, Berk., Grev. Vol. II, p. 6; Sacc. Syll., Vol. No. 7926.

On wood, Lower Carolina. (Type in Herb. Berk., Kew, No. 4088). Forming large tremelloid tufts, always springing from a very small basal portion, which penetrates the matrix; lobes suberect, 3–4 inches high in well grown specimens, sometimes smaller, in some specimens variously plicate and almost free to the base; in others the lobes are united laterally and form a gyrose tuft, always much compressed. The distinctly scabrid surface is very characteristic, and is due to thickly scattered papillæ, which give a very harsh feel to dry specimens. Basidia large, sterigmata developed in succession.

STELLA, Mass. (*nov. gen.*).

(Fig. 2.)

Peridium consisting of two distinct layers united at the base only; outer layer thick, splitting in a stellate manner from the apex, inner layer thin, indehiscent; gleba traversed by numerous anastomosing thin tramal plates, which are continuous with the inner wall; columella and capillitium absent; spores forming a powdery mass at maturity.

The present genus occupies an intermediate position between *Scleroderma* and *Geaster*, agreeing with the former in the structure of the gleba, which is broken up into numerous small, irregular cavities by the tramal walls, which become disorganized at maturity, and in the absence of a columella and capillitium, but is generically distinct in having a peridium composed of two separate layers, in which it agrees with *Geaster*, but is again quite distinct from the last-named genus in the total absence of a capillitium, a character which also distinguishes it from *Diplocystis*, *Diploderma*, and *Cycloderma*, if indeed the last-named genus is founded on anything more than immature species of *Geaster* collected before the splitting of the outer peridium.

2. STELLA AMERICANA, Mass. (*n. s.*). (Fig. 2.) Globoso-depressed, outer layer of peridium thick, *smooth*, *ochraceous-brown*, splitting from the apex in a stellate manner into 4–6 acute subequal segments; inner layer smooth, thin, *pale brown*, becoming disorganized above when mature; mass of spores, *umber*; walls of trama whitish, disappearing; spores globose, *minutely warted*, 6–7 μ in diameter. On the ground, Lower Carolina. (Type in Herb. Berk., Kew, along with *Scleroderma geaster*); from 1–2 inches in diameter, growing singly or sometimes two together.

3. TRICHOSPORIUM CURTISII, Mass. (Fig. 3.) Broadly effused, compact, *blackish-purple*, sometimes with a tinge of brown; hyphæ pale, septate, branched, combined into vein-like anastomosing strands; gonidia very profuse, *purple-brown in the mass*, *smooth*, *broadly elliptical*, rather variable in size, averaging 5 by 3.5–4 μ.

Reticularia affinis, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll., Vol. VII, Part I, No. 1426.

Reticularia atro-rufa, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll. No. 1428.

Reticularia venulosa, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll. No. 1433 (called by mistake *Reticularia venosa.*).

On bark, wood, moss, etc. Lower Carolina, Cuba, Ceylon. (All types in Herb. Berk., Kew.) Superficially resembling a *Reticularia*, but there is no cortex, the surface being perfectly naked. Forming compact cakes, 3–4 inches across and half an inch thick, consisting of a dense mass of hyphæ spreading centrifugally in the form of irregularly anastomosing vein-like strands, produced by the agglutination of hyphæ, brought about by the partial disorganization of their walls. Hyphæ septate, with numerous clamp connections, sometimes minutely scabrid with particles of lime; conidia acrogenous, produced in great profusion, becoming agglutinated into a compact cake along with the hyphal portion of the mass.

4. TRICHOSPORIUM PHYRRHOSPORIUM, (Berk.) Mass. (Fig 4.) Effused, pulvinate, compact, *deep reddish brown*, hyphæ 2–2.5 μ thick, pale yellow, septate; conidia very profuse, produced on the tips of short lateral branches, *globose*, *bright brown*, *smooth*, wall very thick, 6–7 μ in diameter.

Reticularia phyrrhospora, Berk., Journ. Linn. Soc., Vol. X, p. 347 Sacc. Syll., No. 1432.

Reticularia rubra, Ayres, in Herb. Berk.

On dead trees. Mauritius, Cuba. (Type in Herb. Berk.) Forming pulvinate masses 2–3 inches long by 1 inch or more high, seated on a broad base, convex above, sometimes irregular in outline. The conidia are produced on the tips of lateral or terminal branches, the apical cells of which become inflated, and from this inflated apical portion of the terminal cells the conidia are produced; eventually, the inflated apical cell becomes colored like the conidia, and falls away from the colorless supporting hypha; these latter are the bodies referred to by Berkeley as shortly stipitate spores.

5. TRICHOSPORIUM APIOSPORIUM, (B. & Br.) Mass. (Fig. 5.) Broadly effused, *fulvous*, hyphæ agglutinated into radiating dendritic strands; conidia *elliptical*, *minutely verrucose*, almost colorless, 8–9 by 5 μ.

Reticularia apiospora, B. & Br., Journ. Linn. Soc., Vol. XI, p. 82; Sacc. Syll., 1427.

On dead wood. Ceylon, Lower Carolina. (Type in Herb. Berk.) Broadly effused, thin; hyphæ agglutinated into irregularly branched vein-like radiating strands. The conidia spring from subpyriform apical cells as in *T. phyrrhosporium*.

6. BADHAMIA NODULOSA, (Cke. & Bal.) Mass. (Fig. 6.) Sporangia globose, stipitate, wall very thin, almost colorless above, and covered with an irregular scanty white crust of lime, basal portion without lime and beautifully iridescent, becoming irregularly ruptured at maturity; stem longer than sporangium, *weak*, *often subdecumbent*, *brown*, attenuated upwards, longitudinally wrinkled, expanding at the base into a small, irregular hypothallus; columella absent; capillitium well developed, flattened, intricately branching nodes large, irregular, *scantily furnished throughout with granules of lime;* spores globose, dingy lilac, *minutely verruculose*, 8–10 μ in diameter.

Physarum nodulosum, Cke. & Balf., in Rav. Fung. Amer. Exs., No. 479.

On Acacia bark. Aiken, S. Carolina (Rav. 2972). (Type in Herb. Kew.) A very distinct and good species of *Badhamia*, hitherto undescribed so far as I am aware. About 1.5 mm. high, stem twice as long as sporangium, weak, usually subprostrate, capillitium dense, with the characteristic flattenings met with in *Badhamia*, and everywhere containing granules of lime, although the quantity is not so great as is usual in the genus. Sparsely scattered, rarely two springing from the same hypothallus.

7. PHYSARUM SCYPHOIDES, Cke. & Balf. (Fig. 7). Sporangia globose or broadly obovate, stipitate, *upper portion of wall whitish*, rough with amorphous lumps of lime, basal portion *bright brown*, *persistent as a very shallow, irregular cup;* stem about equal to sporangium in length, *bright brown*, erect, usually attenuated upwards, irregularly wrinkled

and often compressed and twisted, expanding at the base into a minute brown hypothallus; capillitium dense, knots of lime white or yellowish, very numerous, large, irregularly branched, connected by short thin portions, *becoming concentrated towards the base of the sporangium to form a columella;* spores globose, lilac-brown, *minutely warted*, 7–9 μ in diameter.

Physarum scyphoides, Cke. and Balf., in Rav. Fung Amer. Exs., No. 480.

On living leaves, grass, etc. Darien, Ga. (Rav. 2407). (Type in Herb. Kew). A fine species, about 1 mm. high, scattered or gregarious, the upper portion of the sporangium whitish, chalky, with sometimes a suggestion of pink, falling away in patches when mature, and leaving the small, thicker, basal portion in the form of an irregular shallow cup or disc, which, with the character of the sporangium, suggest a leaning toward the genus *Craterium*. It is perhaps a mistake to issue new species in exsiccati before the specific diagnoses have been published.

8. TILMADOCHE GYROCEPHALA, Rost. (Fig. 8.) Sporangia stipitate irregularly globose or compressed, *variously lobed and lacunose, umbilicate below*, wall thin, at first frosted with minute greenish-yellow granules of lime, dehiscing irregularly; stem equal to or longer than sporangium, attenuated upwards, strongly wrinkled longitudinally, expanding downwards into an irregular hypothallus, *yellow or orange;* columella absent, capillitium well developed, forming a rigid, irregular net-work; *swellings small, fusiform*, containing yellow granules of lime; spores globose, dingy lilac, *minutely verruculose* 9–12 μ in diameter.

Tilmadoche gyrocephala, (Mont.) Rost. Mon., p. 131; Sacc. Syll., No. 1248.

Physarum Schumacheri, Spr., Rav. Fung. Amer. Exs., No. 4778.

Didymium gyrocephalum, Mont., Ann. Sci. Nat., Ser. II, Vol. VII, p. 362; Mont. Syll., No. 1073.

Cribraria straminiformis, Speg., Fung. Arg., pug. II, No. 109.

On twigs, leaves, etc., Brazil; Argentine Republic; S. Carolina.

Scattered or gregarious 1.5 to 2 millimeters high, characterized by the *gyrose* and *lacunose sporangium*, which, judging from the simple, thin stem, is not an æthalium, as is the case in some species of *Trichia*, *Hemiarcyria* and other genera, where the clustered and fasciculate compound stem proves conclusively the ethaloid nature of the complex sporangium.

KEW, ENGLAND.

A PRELIMINARY LIST OF THE ERYSIPHEÆ OF MONTANA.

By F. W. Anderson.

Whatever effect the abundance or scarcity of rain, or the degree of atmospheric and terrestrial humidity from other sources, may have upon the propagation of *Peronosporeæ* and *Uredineæ*, it is certain that the *Erysipheæ*, in Montana at least, are not very materially affected by even an unusual lack of such moisture. Montana this year, in company with many other Western States, has suffered from an almost unprecedented drought. Yet, while all ordinary vegetation languishes, and while *Uredineæ*, usually so abundant everywhere, are hard to find, the *Erysipheæ* have appeared on most of their usual hosts in fair abundance.

In looking over the published Lists of *Erysipheæ* from various States, or in comparing herbarium specimens of a given species on the same or different hosts from a number of States, one is struck at once by the wide range of variation in the specific characteristics of that species. This is especially noticeable where a species has a wide geographical distribution and a great number of hosts belonging to different families. In fact, it is frequently a difficult task to assign some of these forms which may be intermediate between two related and variable species. For example: Within the range of the two common species of the genus *Erysiphe*—*E. communis* and *E. cichoracearum*—we find at times the most perplexing variations of all kinds, from the form and disposition of the mycelium, up to the number and size of the asci and spores. One is sometimes tempted to think that they are but one "running" species, or else that some day an intermediate specific rank will be erected to embrace the more radical of the intermediate variations from the two types. One or the other alternative must sooner or later be adopted in order to find a resting place for some of the Rocky Mountain forms which are clearly neither the one nor the other, but which are certainly intermediate. There are species in other genera also which would be made easier to deal with by a similar modification. I hope in a future paper to discuss our peculiar Rocky Mountain forms more fully, and with this object in view it may not be out of place at this time to ask botanists of the Rocky Mountain region to send me specimens of the species and forms common to their several localities. I should be happy to send them good specimens from Montana in exchange.

This short preliminary list is published with the hope that other resident or traveling botanists in Montana may be stimulated to a more earnest study of this important family. The species have been collected by myself on the hosts and in the localities given except as otherwise indicated. Spring Hill is on the Idaho border at the southwest, west of the main divide. The Valley of the Teton is near the British line

at the north and east of the main divide. Montana contains 143,776 square miles, and is more than twice as large as all the New England States put together, so that some of our species have a very fair range. I have found that where a host common throughout both sides of the main divide of the Rockies occurs, the fungus will be found throughout also.

SPHÆROTHECA MORS-UVÆ, (Schw.) B. & C. Hosts: *Ribes floridum*, Helena (Kelsey); *R. cereum*, Helena and Great Falls; *R. rotundifolium*, Sand Coulee. Mycelium at first white, but soon becoming dark brown, forming a dense felt over the succulent twigs and young leaves of *Ribes rotundifolium;* occurring also upon the berries. On *Ribes cereum* it is less frequent, and usually grows in small isolated belts around the young twigs. At times very injurious to the gooseberry. Unusually prevalent this year.

SPHÆROTHECA CASTAGNEI, Lév. Hosts: *Geranium incisum*, Helena (Kelsey), Sand Coulee, Belt Mountains; *Geranium Richardsoni*, Belt Mountains; *Gilia linearis*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Willis, Glendale, Dillon, Spring Hill, and Valley of the Teton; *Gilia gracilis*, Belt Mountains; *Shepherdia argentea*, Valley of the Teton, throughout on *Gilia linearis*, frequently killing it; covering all parts of the plant above ground. The thousands of black perithecia, mixed with the gray mycelium, make infested plants look as if covered with small particles of black soil mixed with dust. Rare on *Gilia gracilis*. On *Shepherdia argentea* the disposition of the mycelium was much like that of *Sphærotheca mors-uvæ*; but more delicate, colorless, or faintly creamy-yellow tinged, and not so evident; that is to say, it attacks the tender twigs of the tree and surrounds them, causing injury to the leaves above by perversion of nutrition. It is also very partial to the leaf axils. My specimens were collected July 16, this year. The ascospores are formed, but the fungus is not mature. Mr. J. B. Ellis, who kindly compared my specimen with one from Dr. Farlow, agrees with me that it must be referred as above. Common in the mountains on *Geranium incisum* and *G. Richardsoni*, often thickly covering the petioles, leaves, stems, and even the petals, sometimes causing the leaves to curve to the ground with the weight of fungus and destroying them.

A quite remarkable form of this species was found on *Heuchera parvifolia*. Anderson No. 212. Sand Coulee, Cascade County, Mont., December 3, 1888. Its most marked peculiarity is in the mycelial threads, which have a tendency to grow to a great length without ramifying to any extent, and end in long, slender, cylindrical, colorless threads. Moreover, they show marked constrictions at nearly regular intervals, at which they are septate. The appendages can be readily distinguished from the mycelium, are strongly colored for about one-third to one-half their length, and then gradually fade to the almost hyaline tip. Like the mycelium, they are septate and show a tendency to elongate without

interweaving much with other threads. Conidia-bearing branches are scarce, and the only perfect (?) one I could fine bore three conidia.

ERYSIPHE COMMUNIS, (Wallr.) Fr. Hosts: *Œnothera albicaulis*, Sand Coulee; *Oxytropis Lamberti*, Sand Coulee, Great Falls, Valley of the Teton, Craig, Helena, Deer Lodge, Dillon, Spring Hill; *Astragalus Canadensis*, Helena (Kelsey), Belt Mountains; *A. multiflorus*, Belt Mountains; *A. decumbens*, Belt Mountains; *A. hypoglottis*, Sand Coulee, Helena, Willis; *Pisum* (cultivated), Willis, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee; *Trifolium longipes*, Deer Lodge Valley and Belt Mountains; *Lupinus parviflorus*, Deer Lodge and Spring Hill; *Amelanchier alnifolia*, Helena (Kelsey), Sand Coulee; *A. maculatum*, Sand Coulee; *Ranunculus repens*, Helena, Deer Lodge, Willis; *R. macranthus*, Great Falls, Belt River; *R. Cymbalaria*, Sand Coulee, Helena, Deer Lodge, Dillon, Willis, Glendale, Melrose, Spring Hill, Valley of the Teton; *R. sceleratus*, Sand Coulee, Helena. Doubtless on many other hosts. The forms on *Ranunculaceæ* commonly have very dark appendages, especially the form on *R. Cymbalaria*. The appendages of the forms on *Leguminosæ* are lighter or even entirely colorless, and often indistinguishable from the mycelium at maturity. This fungus is especially destructive to *Ranunculus Cymbalaria*, *Oxytropis Lamberti*, and cultivated *Pisum*.

ERYSIPHE GALEOPSIDIS, DC. Host: *Stachys palustris*, Helena (Kelsey), collected August 26, of this year, but not well matured. The abundant mycelium develops on all parts of the plant above ground. Occasionally asci are seen nearly double the ordinary length, constricted at the middle and septate; they were seen (several in one perithecium and one or two in others) clustered with the other asci. The spores, which are not mature, are usually narrowly elliptical to linear and acute at both ends.

ERYSIPHE CICHORACEARUM, DC. Hosts: *Mertensia Sibirica*, Belt Mountains; *Phacelia Menziesii*, Silver City (Kelsey); *Parietaria debilis*, Sand Coulee; *Verbena hastata*, Helena (Kelsey); *Galium Aparine*, Sand Coulee; *Echinospermum Redowskii*, Helena (Kelsey); *Solidago Missouriensis*, Sand Coulee, Belt Mountains; *S. serotina*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Dillon, Spring Hill; *S. rigida*, Sand Coulee, Belt Mountains, Belt River, Craig, Helena, Deer Lodge, Butte, Silver Bow Junction, Dillon, Willis, Spring Hill, Valley of the Teton; *S. nana*, Belt Mountains; *S. occidentalis*, banks of the Upper Missouri River; *Aster lævis* and forms, Sand Coulee, Belt Mountains, Helena, Deer Lodge, and Dillon; *A. conspicuus*, Belt Mountains; *A. longifolius*, Belt Mountains, Helena, Warm Springs Asylum; *A. commutatus*, Sand Coulee, BeltRiver, Cora Creek Station, Great Falls, Helena, Deer Lodge, Dillon, Willis; *A. canescens* and forms, Sand Coulee, Belt Mountains, Belt River, Mt. Helena, Deer Lodge, Warm Springs Asylum, Spring Hill; *A. multiflorus*, Belt River, Otter Creek, Cora Creek Station; *A. foliaceus* and vars., Sand Coulee, Helena, Deer Lodge, Dillon, Warm Springs Asylum; *A. adscendens*, Belt River; *Erigeron macranthus*,

Elkhorn (Kelsey), Belt River, Belt Mountains, Sand Coulee, Helena, main range of the Rockies, Deer Lodge, and Willis; *E. glabellus*, Belt Mountains; *E. divaricatus*, Sand Coulee, Belt Mountains; *E. Canadensis*, Sand Coulee, Helena, Dillon; *E. corymbosus*, Belt Mountains; *E. armeriæfolius*, Helena; *E. strigosus*, Sand Coulee; *Helenium autumnale*, banks of the Big Hole River, near Willis; *Helianthus annuus*, Helena (Kelsey); *H. Californicus*, var. *Utahensis*, Helena (Kelsey); *Gaillardia aristata*, Mount Helena; *Lactuca pulchella*, Sand Coulee; *Artemisia dracunculoides*, Belt Mountains, Belt River, Cora Creek, Otter Creek, Chinook, Valley of the Teton, Sun River, Fort Shaw, Fort Assinniboine, Sand Coulee, Craig, Helena, Garrison, Deer Lodge, Butte, Silver Bow Junction, Silver City, Willis, Melrose, Glendale, Spring Hill; *A. Ludoviciana*, Belt Mountains, Valley of the Teton, Belt River, Otter Creek, Helena, Craig, Deer Lodge, Dillon, Warm Springs Asylum, Willis, Great Falls, Sand Coulee, Sun River; *A. discolor* and forms, Belt Mountains; *Bigelovia graveolens* and vars., Falls of the Missouri River, Helena, Deer Lodge, Warm Springs Asylum, Dillon, Glendale, Melrose, Willis, Chinook, valley of the Teton, Spring Hill; *B. Douglasii* and forms, Mount Helena, McCarthy Mountains, Willis, Deer Lodge, Spring Hill; *Chrysopsis villosa* and forms, Sand Coulee, Deer Lodge, Willis; *Grindelia squarrosa*, Sand Coulee, Helena, Deer Lodge, and Willis; *Cnicus undulatus*, Sand Coulee, Helena, Deer Lodge, McCarthy Mountains near Willis, valley of the Teton; *Gutierrezia Euthamiæ*, Sand Coulee and Deer Lodge.

A number of the forms of *Erysiphe cichoracearum*, DC., to be found on the hosts given are far from typical—especially on certain of the *Compositæ*, and are placed here because at present there is no other place to put them. In some, one, in others another character fails, and again nearly all may fail; not the least important of which is to be considered the remarkable variation in the number of spores to an ascus. In the *Verbena hastata* specimens the asci contain frequently but one spore and that of but average size. The perithecia of *Phacelia Menziesii* specimens are very dark, in marked contrast with the rather pale appendages. All parts of the plant are overrun by the fungus. The fungus covers *Echinospermum Redowskii* entirely. Sometimes large patches of the host growing in dry gravelly places along railway tracks are almost white with growth of mycelium. *Parietaria debilis* suffers so severely from this fungus that its leaves rot on the stems, and if one attempts to pull a leaf off it is no uncommon thing for an irregular piece to come away between one's fingers, leaving the other dilapidated portion still hanging. In *Compositæ* the *Artemisiæ*, with *Aster foliaceus*, *Aster canescens*, and *Aster commutatus* suffer most severely. Cultivated plants do not appear to be infected. In connection with the fungus on *Cnicus undulatus*, collected at Helena, I found the conceptacles of *Cicinobolus Cesatii*, DBy. They were confined chiefly to the conidia-bearing hyphæ, pale in color and small, probably young, for no spores were seen to

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escape from crushed conceptacles. They produced no perceptible distortions in the form of the host hyphæ, their own hyaline, delicate mycelium running along the center of the hyphæ for great lengths. I regret that no drawing or fuller notes were preserved. Recently, I have found the same fungus in the hyphæ of *Erysiphe cichoracearum*, DC., on *Gutierrezia Euthamiæ*. The host mycelium was much distorted; here and there colored brown and containing a brownish granular substance—probably the forming conceptacles of the *Cicinobolus;* while, at intervals, the mature conceptacles, varying much in size, arose directly from the usually prostrate hyphæ. Some of these conceptacles were larger than the half-grown perithecia of their host. Their mycelium appeared to ramify with the ramifications of the host mycelium and the conceptacles were most frequently developed near the terminal of a host hypha, or at the terminal of one of its branches, or sometimes from the center of a hypha. Although young and half-grown perithecia of the host were in fair abundance, there was a great scarcity of vegetative mycelium, unusual in this species on any of our hosts. Conidia were also scarce, and it is extremely probable that they were prevented from so much as partially forming by the fructification of the *Cicinobolus* taking possession of the conidial branches at an early stage of their growth. The *Cicinobolus* spores could be found in great numbers, issuing from the ruptured conceptacles. They varied somewhat in shape, occasionally slightly constricted at the middle; usually straight and oblong or narrowly oval. They soon scattered in every direction under the cover glass. None of them appeared to be nucleate.

ERYSIPHE GRAMINIS, DC. Hosts: *Glyceria nervata*, Sand Coulee; *G. aquatica*, Sand Coulee; *Agrostis exarata*, Sand Coulee; *Beckmannia erucæformis*, Sand Coulee; *Hordeum jubatum*, Sand Coulee; *Poa tenuifolia*, Sand Coulee, Helena, Deer Lodge, Willis, and Spring Hill; *Agropyrum glaucum*, Sand Coulee, Great Falls, and Sun River Valley. This common fungus has been found to have mature ascospores in October on *Beckmania erucæformis*, *Hordeum jubatum*, and *Poa tenuifolia*. Perithecia varying in size have been found on all but the *Agrostis exarata*. On *Poa tenuifolia* the ascospores are mature by November, and usually by the middle of October. Professor Galloway informs me that in Missouri, on another species of *Poa*, this fungus was found by Prof. S. M. Tracy containing ripe ascospores in July. In the forms on all the grasses mentioned excepting *Agropyrum glaucum*, the mycelium is at first snow white, and so far as seen never turns yellow or brown, although with age it may assume a grayish tint. The fungus occurs mainly on the upper surface of the leaves in *Beckmannia erucæformis* and *Hordeum jubatum;* on the other grasses it is found abundantly on both surfaces. The form on *Agropyrum glaucum* is colored, almost if not quite from the first, and soon becomes brown or even rusty red, dense and felted, forcibly reminding one of the mycelium of *Sphærotheca mors-uvæ* by its appearance *en masse*. In pressing or drying it loses much of its characteristic appearance.

I have not examined the perithecia of specimens collected later than August, at which period the spores are unformed, or at most only just beginning to show around the inner wall of the ascus. So far as this could be studied it accorded better with the description of the European plant than most of those in my herbarium bearing the same name from any American locality. But none of ours that I have seen agree with the number of asci given in the description "asci 8–16," while ours are 10–25, commonly the greater number. The form on *Poa tenuifolia* does not at all accord with the description and may yet be separated as a good species. This fungus is remarkably destructive to the *Poa* and may be found literally covering it—as if a bucket of whitewash had been spilt over the grass—even on dry, gravelly hills from 7,000 to 9,000 feet high. Deer Lodge Valley is in altitude over 6,000 feet and the high hills and mountains in the vicinity, which are dry and nearly bare of other vegetation than a sparse growth of this grass, form a rich collecting ground for various *Erysipheæ*. *Erysiphe graminis* on *Poa tenuifolia* will be found an excellent subject for those who wish to study the development of the mycelium from the conidia and the sexual organs and ultimate fruit from the mycelium.

UNCINULA SALICIS, (DC.) Winter. Hosts: *Salix glauca* (a form) Helena (?) (Kelsey), Belt Mountains; *S. rostrata*, Belt Mountains; *S. longifolia*, banks of the Upper Missouri River, and Dillon; *S. amygdaloides*, banks of the Upper Missouri River, valley of the Teton, and Sun River Valley; *S. cordata*, banks of the Upper Missouri River; *S. flavescens* and vars., Belt Mountains, Helena, Deer Lodge, Warm Springs Asylum, McCarthy Mountains, Melrose, Spring Hill; *Populus tremuloides*, Sand Coulee, Helena, Deer Lodge, Willis, Spring Hill; *P. monilifera*, banks of the Upper Missouri River, Deer Lodge, Dillon, Willis; *P. balsamifera*, Deer Lodge, Dillon, Willis, Spring Hill; *P. angustifolia*, Helena, Deer Lodge, Willis. This beautiful species is widely distributed and varies considerably on the different hosts, especially as regards appendage tips and number of spores in an ascus. In some instances the appendage tips are almost straight and scarcely swollen in well matured specimens; but such variations are to be expected and are of no specific importance within certain limits.

PHYLLACTINIA SUFFULTA, (Reb.) Sacc. Hosts: *Heuchera parvifolia*, Sand Coulee; *Typha latifolia*, Helena; *Betula occidentalis*, Helena (Kelsey); *Cornus stolonifera*, banks of the Upper Missouri River, Helena, Dillon, Willis, Spring Hill; common and variable; sometimes causing marked injury to the leaves of hosts.

PODOSPHÆRA OXYACANTHÆ, (DC.) DBy. Host: *Prunus Virginiana*, Sand Coulee, Mount Helena. More prone to attack the leaves of vigorous shoots in shady places. Not particularly abundant.

MICROSPHÆRA SYMPHORICARPI, Howe. Hosts: *Symphoricarpus occidentalis*, Sand Coulee, Belt River, Sun River Valley, Craig, Helena, Deer Lodge, Dillon, banks of the Big Hole River near Willis, banks of

the Red Rock River near Spring Hill, Valley of the Teton; *S. racemosus* var. *pauciflorus*, Belt Mountains. More prolific on the former host; sometimes covering both surfaces of the leaves, causing them to fall before their season.

MICROSPHÆRA GROSSULARIÆ, Lév. Hosts: *Ribes rotundifolium*, Sand Coulee; *R. floridum*, Sand Coulee and Helena; *R. nigrum* (cult. black currant), Sand Coulee. The perithecia and contents usually mature in late autumn, when the leaves begin to fall.

MICROSPHÆRA RAVENELLII, Berk. Hosts: *Astragalus adsurgens*, Sand Coulee, Helena, Deer Lodge, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee, Helena, Deer Lodge, Willis, Belt Mountains, and the Valley of the Teton. Very abundant on the latter host, stunting its growth and preventing the production of flowers.

It will be evident from the following table that there are still many common and good-sized families whose members are attacked by *Erysipheæ* that are not represented in our list. Active workers may expect a rich harvest in Montana for several years to come. The work is in its infancy here, and the only active students are Mr. Kelsey and myself. We want more in the field. I have made several flying trips to points all over the Territory, only getting together a dozen species on ninety odd different hosts. What we need is more local collectors who can do thorough work in their own vicinities. This want will doubtless be supplied as our new State grows older.

Orders represented among host plants.	Number of genera in the order.	Number of species in the order.
Ranunculaceæ	1	4
Geraniaceæ	1	3
Sapindaceæ	1	1
Leguminosæ	4	10
Rosaceæ	2	2
Saxifragaceæ	2	5
Onagraceæ	1	1
Cornaceæ	1	1
Caprifoliaceæ	1	2
Rubiaceæ	1	1
Compositæ	11	35
Polemoniaceæ	1	2
Hydrophyllaceæ	1	1
Borraginaceæ	2	2
Verbenaceæ	1	1
Labiatæ	1	1
Elæagnaceæ	1	1
Urticaceæ	1	1
Cupuliferæ	1	1
Salicineæ	2	10
Typhaceæ	1	1
Gramineæ	6	7
Total in twenty-two orders	44	93

rysipheæ represented by 6 genera and 13 species.

STATUS OF THE SORGHUM BLIGHT.

By W. A. KELLERMAN and W. T. SWINGLE.

Attention is called to two papers, whose titles in full are as follows:

(1) *Notizie preliminari sopra alcuni fenomeni di fermentazione del Sorgo saccarino vivente* (Preliminary notice concerning phenomena of fermentation in living saccharine sorghum). *Nota dei Socii corresponденti Palmeri e Comes. Adunanza del dì* 1° *dicembre* 1883. *Estratto dal Rendiconto della R. Accademia delle Scienze fis. e mat. di Napoli. Fascicolo* 12° *dicembre* 1883.

(2) *Una Rivendicazione di Priorità sulla Malattia del Sorgo saccarino* (A vindication of priority concerning the malady of saccharine sorghum). *Pel Socio Dr. O. Comes. Adunanza del dì* 8 *agosto* 1889. *Estratto dal Rendiconto del Reale Istituto d' Incoraggiamento. Fascicolo* 7° *e* 8° *luglio e agosto* 1889.

The authors of the first paper, Professors Palmeri and Comes, noticed in 1882 in the expressed juice of saccharine sorghum minute forms similiar to ferments, but they made no further observations in regard to the same until the following year. In 1883 they found at Castellammare (Italy) that the canes presented a conspicuous coloration; in some cases the whole interior portion of the cane was red. This condition gave rise to the suspicion that here was presented the effect of the attack of *Ustilago Reiliana*, Kühn. But on the other hand, they noticed an increase of temperature in a bundle of canes, which was still more marked in a heap of reduced cane awaiting the extraction of the juice. The juice obtained was red in color and immediately underwent spontaneous alcoholic fermentation which was accompanied, or at least immediately followed, by an acetic fermentation. Examination was then made to determine whether fermentation took place in the juice previous to its extraction. For this purpose a cane was made use of that had been in store for eight days. It was cut into small pieces, put into water and subjected to distillation. The distilled liquid gave an alcoholic odor and furnished also, with Muntz's method, evidence of alcoholic content.

Professors Palmeri and Comes then sought to determine whether similar results would be obtained both in the vigorous growing canes attacked with the *Ustilago*, and also in healthy and uninfected plants. They took for this purpose from a farm at Ponticelli a few plants presenting the red discoloration, and others that showed no signs of the disease. Distillation one hour later resulted in the detection of alcohol in the case of the red canes, but none was found in case of the normal and healthy plants.

Sound canes were uniformly found to be white within, but affected ones were a red orange color. The coloration appears first in the fibrovascular bundles. It is light yellow, but in marked contrast to the

adjacent tissue. Later the color deepens to a more or less intense orange, and the fibro-vascular bundles appear as red lines. Finally the adjacent tissue also becomes colored, first at isolated points and then throughout. At this stage the fibro-vascular bundles become altered to a brown color. The red coloration may be manifest, both in the tissue of the internode and in the leaf sheath, or it may be limited to the leaf sheath. In the latter case the corresponding fibro-vascular bundles of the internode are slightly yellow, and those of the leaf sheath are violaceous. But if the internodes and leaves are contemporaneously reddened it was found that the fibro-vascular bundles of the leaves first redden; then the coloration passes along the bundles into the stems. If the node be examined in longitudinal section the red strands will be seen entering from the leaf sheath. In fact the fibro-vascular bundles (with the surrounding tissue) are colored their entire length, and the coloration passes from the leaf to the node, thence with the elaborated sap through the internodes.

Upon microscopic examination the investigators found the red coloration to be due to a deposit on the cell walls. Under strong magnification colorless micro-organisms of various sizes and forms were detected. The larger ones were elliptical, the smaller almost spherical and highly refractive. The first propagate by budding and appear in colonies of two or three individuals united by germination. Some of them are homogeneous, but many present a luminous point in the center or a point at each end; still others have three points, namely, one in the middle and one at each end. The presence and number of these luminous points depend on the stage of development of the cell. Their length (5–7μ) is about twice their breadth (2–3μ).

These micro-organisms, according to Professors Palmeri and Comes, probably correspond to the species figured by Bonorden, Handb. All. Mykol. taf. I Fig. 2 and called *Hormiscium sacchari*. This ferment is very probably the same as that which was afterwards named by Rees *Saccharomyces ellipsoideus*. The spherical or subspherical micro organisms mentioned above are scarcely 1μ long and present an active vibratory movement. They should perhaps be referred to *Bacterium termo*, Djr.,which is commonly found in juices and tissues undergoing decay.

A positive demonstration of the mode of entrance of the germs into the tissue is not claimed, yet it was suspected from observations above given that they enter from without—which is corroborated by the following. "Not only is there a whitish cereous coating, but also another, especially under the sheaths of the affected stems, which is frost-like, greasy white, and cinereous. Microscopic examination reveals the fact that this lime-like coating consists of myriads of organisms like those found in the juices. The diseased plants remaining on the ground afford in their amylaceous or saccharine contents opportunity for increase of the micro-organisms, which are then finally wafted hither and

thither by the breezes. Disseminated in this manner they reach the leaves of the sorghum plants, upon which, in the presence of mists and rain, they multiply and pass through casual wounds or through stomates into the leaves, thence with the elaborated sap to the tissues of the stalk." This hypothesis is supposed to be justified further by the observation that the disease was more intense during the spring fogs and on manured soil where the development of such germs is common. This was the case at Castellammare, where the material for study was obtained.

We have thus given in detail the account of these interesting investigations (in fact this may be considered for the most part merely a free translation of the paper) though carried on five years ago, for the reason that no extended notice of the same has hitherto been given in this country. It was reviewed in the *Botanisches Centralblatt* XXIII, 19 (1885).

In the second paper "Vindication of Priority," Dr. O. Comes, after referring to Professor Burrill's and our own investigations of the Sorghum disease, calls attention to his researches published in 1883 and maintains most positively that the disease studied by himself and Professor Palmeri is the same as that discovered by Professor Burrill in Illinois and further studied by us in Kansas.

Professor Burrill's accounts are as follows: "A Disease of Broom-corn and Sorghum," in the eighth annual meeting of the Society for the Promotion of Agricultural Science, 1887, pages 30–36, and in the Fourteenth Report of the Board of trustees of the University of Illinois for the two years ending September 30, 1888, pages 215–222; and "Disease Germs; another illustration of the fact that bacteria cause disease," in The Microscope, Vol. VII, No. 11, pages 321–331, taken from the Transactions of the American Society of Microscopists, 1887. Our accounts are as follows: "Preliminary Report on Sorghum Blight" in Experiment Station, Kansas State Agricultural College, Bulletin No. 5, pages 56–60, December, 1888; and "Sorghum Blight" in the First Annual Report of the Kansas Experiment Station, State Agricultural College, for the year 1888, pages 281–315.

It is not so clear to us as it is to Dr. Comes that the disease detected by him is the same as that studied by us, and for conclusive evidence we await further investigation on both sides. Dr. Comes dealt with a form of disease characterized by evident alcoholic (and acetic) fermentation. No fermentation whatever was detected either by Professor Burrill or ourselves. Stress it seems to us should be laid on this fact.

He says, in reference to the microbe which he found, that he first thought he had to do with a saccharomycete, but convinced himself the following year that it was a schizomycete and referred to *Clostridium butyricum* (Pasteur), Praz. in "*Il marciume delle radici e la gommosi nella vite*, Napoli, 1884" We would note in reference to this species that ac-

cording to Prazmowski, "*Untersuchungen über die Entwickelungsgeschichte und Fermentwirkung einiger Bacterianarten* and the description in Schrœter's "*Kryptogamen-Flora Schlesiens*," III, Band, Pilze, S. 166, it is a very different organism from *Bacillus sorghi*, Burrill. As figured by De Bary, "Lectures on Bacteria," 2nd. Ed., English translation, page 100, Fig. 13, it somewhat resembles the form shown by us, Plate IV. Fig. 5, *l. c.* which is wholly unlike *Bacillus sorghi*. In the latter no germination of the spores could be seen, while in *Clostridium butyricum* they are said to germinate from the end and are so figured by Prazmowski, *l. c.*

Dr. Comes further says that not having material at hand at the time of writing the "Vindication" he was unable to confirm his former reference of the microbe to the one previously described or to determine whether it be new (*Bacillus sorghi*) as Professor Burrill decided. He says that the description and figures given by Bonorden correspond precisely to the microbe under examination, and also states that his own description of the organism corresponds exactly to that made by Burrill, and to the Figures 1, 2, 3, 4, 5, and 6, Plate IV, of the Report of the Botanical Department of the Kansas Experiment Station, 1888, except that his is a little larger than ours. Now, it should be noticed that whereas our Figures 1, 2, and 3 represent the *Bacillus sorghi*, Figures 5 and 6 represent Bacilli very different in size and character and only occasionally found as impurities in cultures.

The difference in size of the micro-organisms found by Dr. Comes and of *Bacillus sorghi* is by no means inconsiderable. His were 5–7μ long and 2–3μ wide. The measurements of *Bacillus sorghi* are only $1\frac{1}{3}$–4 by $\frac{1}{2}$–$1\frac{1}{4}\mu$, mostly $1\frac{1}{1\,2}$–3 by $\frac{3}{4}$–1μ. Moreover, if Bonorden's figures (taf. I, Fig. 2, and description of species page 33, *l. c.*) be examined it will be seen that they are very different from our figures of *Bacillus sorghi* referred to by Dr. Comes, and Bonorden's can not for a moment be regarded as representing the species with which we had to deal.

The *Micrococcus* figured by us (Plate IV. Fig. 4. *l. c.*) was also found by him and referred to *Bacterium termo*. The figure alluded to, no less than our (unpublished) description of the organism, shows that it is not *Bacterium termo*, but a *Micrococcus* measuring only $\frac{1}{2}$–$\frac{3}{4}$ μ in diameter.

The interior tissue of the cane when diseased (and the disease appeared within only where the stalk had been wounded) was uniformly colored in specimens examined by us. We found in no case colored fibro-vascular bundles surrounded by white tissue. Dr. Comes found the fibro-vascular bundles either light yellow or highly colored and surrounded by white tissue.

The disease in Italy was found in the saccharine sorghum, presumably *Sorghum saccharatum;* that which we studied is in *Sorghum vulgare*, and so far as known to us at present does not occur on *Sorghum saccharatum*.

Finally we observe that the symptoms of the sorghum disease reported by Dr. Comes do bear, at least superficially, a marked resemblance to sorghum blight studied by us, yet at the same time the microbes appear to be quite different. At any rate a fuller diagnosis, showing more points of resemblance, may perhaps reasonably be expected in order to establish the identity of the disease occurring in Italy and in the United States.

NOTE BY T. J. BURRILL.

Through the kindness of Professor Kellerman I have had an opportunity to examine the manuscript by himself and Mr. Swingle in reply to the respectful claim of priority on the part of Dr. Comes in the matter of sorghum blight. The reply seems to me well made and fairly states the case upon both sides. I will here say that I had seen the notice in the *Botanisches Centralblatt*, XXIII. 19 (1885), before my first paper upon the subject was published, and really intended to refer to it. However, it seemed certain to me that the disease there alluded to could not be that with which I was engaged. This certainty was the primary cause of the omission of my intended reference, since I filed my note made at the time of reading the article among those of general plant diseases instead of among those due to bacteria, and thus overlooked it when the manuscript was prepared. Further, the tissues of growing sorghum plants are very likely to turn red when injured in any way, even by mechanical wounds, while the fact that alcohol was cited as a product and a *Saccharomycetes* as an agent clearly separated the characteristics of the diseases studied. It is certain that alcohol is not found directly connected with what is called sorghum blight in America. It seems to me impossible that any one could mistake the organism described as the cause of this last for either *Bacterium termo* or *Clostridium butyricum*, not to speak of a *Saccharomycetes*.

However, if this sorghum blight was really investigated in Italy before it was in America, no one will more cheerfully accept the fact than myself whether or not the authors properly described what they saw.

ROOT FUNGUS OF NEW ZEALAND.

By R. Allan Wight.

This fungus in the mycelial stage attacks a great variety of tree roots, amongst the most conspicuous of which are the apple, pear, peach, and all other common orchard trees. The white thorn is also very subject to its attacks, as well as a great many *Abies* and several of the native trees and plants. It also attacks the cabbage, the potato, docks, sorrel, fern, and in fact is almost omnivorous, which is a marked peculiarity.

The only plants I have ever known to resist it are resinous pines and roses; the former suffer at first and the leaves turn yellow, but they ultimately recover, and I never knew one to succumb, whereas the contrary is the case with all other plants attacked.

In hedges of white thorn where roses have been planted at intervals, the thorns are killed and the roses remain intact and quite uninjured. In an orchard it will appear in patches, killing the fern and sorrel and spreading until it reaches a fruit tree; it then attacks the bark round the stem just under the ground, which speedily rots, presenting the appearance of having been cooked, and has an offensive smell; it then proceeds along the roots and the tree soon shows withered leaves, which drop off, leaving it bare, and by and by it falls over and lies on the ground. Its movements are uncertain; sometimes a tree here and there dies; sometimes a whole row and very often acres are swept off. Many entire orchards of fine trees are killed in a few years. This fungus is never found in clay or other damp soils, but always in dry friable lands. Professor Kirk of Wellington says it is *Lycoperdon gemmatum*, Batsch., and that "tar water" is a certain cure. The last statement is assuredly an error, and I think the first is also. For a great many years I have endeavored in vain to procure the fruit of this fungus, using all the means that suggested themselves to me, without any success. I have seen large quantities of the *L. gemmatum* growing in orchards where there is no root fungus, and I have seen a very great many orchards and watched several closely where hundreds of trees are attacked and could never find the mycelium connected with the *Lycoperdon*.

The pest is most plentiful on the skirts of the primeval forests and on fern lands adjoining where no cultivation has ever been resorted to. Whole crops of potatoes are destroyed on such lands, and on dry lands where native tree stumps remain it is very prevalent. My own opinion is that it is a fungus native to and probably peculiar to New Zealand (in the North Island only). All my experiments with sulphur and lime have failed. Kerosene-oil used in winter has alone been of any use, and that has been used pure in winter without killing the tree. The fungi of New Zealand are legion and very destructive, but this is the worst, and particularly as it is confined to dry soils. Where I am now writing 500 trees have been killed within the last two years, and all remedies tried have failed. The apple-scab, the shot-hole fungus, the oidium of the vine are terrible pests in New Zealand, and the settlers have more to to fear from fungous growths than insect pests.

AUKLAND, NEW ZEALAND.

SOME NOTES UPON ECONOMIC PERONOSPOREÆ FOR 1889 IN NEW JERSEY.

By Byron D. Halsted.

Early in the season as announced in the *Botanical Gazette* for June, page 152, a peronospora was found upon cucumber leaves growing under glass here in New Brunswick. The disease assumed a violent form, and in the course of a few weeks all the vines were dead. Squash seed was afterwards sown in the same bed to determine whether the peronospora would develop upon this near relative of the cucumber. In the meantime the mildew, which seemed to be new, was studied; the method of germination by zoospores, and other points were determined and specimens with drawings were afterward sent to Dr. Farlow.

An account of this peronospora was given by Dr. Farlow in the *Botanical Gazette* for August, page 189, in which it was stated that the same species had been found a few months before in Japan, and that it was *Peronospora Cubensis*, B. & C., first found in Cuba on *Cucurbitaceæ*, and described several years ago.

Leaving aside the interesting fact of the widely separated points where this fungus has been found the readers attention is called to the economic side of the question, for not only were the squash leaves of plants growing in the hot-bed infected, but squash and pumpkin vines in various parts of the State were seriously attacked. The writer made it a point to look for this mildew as he visited various counties, and in all cases it was met with, and in some instances was so abundant as to discolor and destroy the leaves before they had attained full size.

The squash plant, from its habit of growing horizontally upon the ground and bearing large, widely separated leaves, is an easy one upon which to study the development of this fungus. It was never found upon the young leaves, but it followed some distance after and became manifest, for example, upon the fourth or fifth leaf from the extremity of the vine. The greenish yellow patches are first seen, and these are small and irregular in shape, being bounded by the veinlets. The spores are borne upon the under side of these patches and when mature are remarkably dark in color. This color is much darker upon the squash than the cucumber, and there are other differences which would be amply sufficient to warrant a varietal name if it was not evident from the hot-bed experiment that the differences are very probably entirely due to the influence of the host. During another season, should this pest return, it is hoped that other experiments will be made to determine more fully the habits of this fungus. As yet no oospores have been found. It should also be said that the attacks of this peronospora upon the cucumber were not confined to those growing under glass, but instead almost ruined some large fields of this plant. From the fact

that this fungus is closely related to the downy mildew of the grape it is safe to conclude that an occasional spraying of the vines with either the Bordeaux mixture or the ammoniacal solution of copper carbonate would prove an effective remedy. The only difficulty will be experienced in getting the liquid upon the under surface of the leaves, where it should lodge to be of most value. It remains to be seen whether the peronospora will attack and damage the water-melon, musk-melon, citron, and other cucurbitaceous plants related to the pumpkin, squash, and cucumber.

The potato rot (*Phytophthora infestans*, DBy.) has been unusually abundant in New Jersey, so much so that many large potato-growers have secured only a small fraction of a crop. The exceptional season has been a hard blow to the rot-proof theory that some "potato-seed" dealers have advanced. As far as observed there has been no one sort of potato that failed to be attacked when the conditions of moisture, warmth, etc., were most favorable. Apparently healthy potatoes secured from areas where most of the tubers have decayed show the threads of the fungus in the tissue, and especially in that portion in the vicinity of the eyes. Many farmers are still to be convinced that there is any danger in using such potatoes for the next season's planting.

In July some of the vines of *Ampelopsis veitchii*, commonly known as the Boston ivy, were found infested with a peronospora, that proved upon examination to be the *P. viticola*, DBy., so prevalent upon the cultivated grapes. Only a few plants out of many hundreds that are to be found in this vicinity were attacked, and all of these were young vines. In no case was any long petioled or divided leaf found with the mildew. The upper and exposed side of the infested leaves became prematurely bright-colored over the attacked portion; while beneath, the conidiphores were short, quite evenly set, and when the spores were mature the characteristic frosty appearance prevailed. It is evident that this is not a favorite host for the peronospora, and in ordinary seasons the vines will very likely not suffer from it. The native species of ampelopsis (*A. quinquefolia*) was often found near mildewed plants of the Boston ivy, but in no case was any of the fungus found upon this. It is, however, a well-known host.

The last peronospora of the season is that of the cultivated violet, (*V. odorata*), and was found upon leaves sent to the station by a grower of violets for the New York market, who claims that his crop is a failure and the loss is hundreds of dollars. A comparison of this peronospora was made with *P. violæ*, DBy., as found upon *Viola tricolor* var. *arvense* and distributed in Ellis' N. A. F. (No. 2207). The latter is placed among the species with dichotomous (uniformly forking into two parts) branching of the spore-bearing threads. In the form upon *V. odorata* there is no indication of this form, but instead it is quite like the mildew upon the grape in the manner of bearing the spores. Again, the spores of the two are different in size, shape, and color. It is true

that the size and color differences may be due to age, but in the *P. violæ* proper the spores are ellipsoidal, while in the other they are nearly perfect spheres. No oospores have yet been found. Whether it proves to be the same species or not, and that can be settled probably by cultures, the fact remains that one of our choicest of hot-bed plants is attacked by a mildew that from its destruction attracts the attention of the violet grower and should be treated with fungicides. A weak solution of the ammoniacal carbonate of copper would be likely to prove an effective remedy.

Among the species of cystopus, all of which have been abundant, only one need be mentioned here. The search, among students of this genus, for the oospores of *Cystopus ipomœæ-panduranæ*, Schw. (*C. Convolvulacearum*, Otth.) upon wild sweet potato, or Man-of-the-Earth (*Ipomœa pandurata*), a miserable weed with enormous roots, has been prolonged and was rewarded only recently, as stated by Dr. Farlow in *Botanical Gazette* for August, page 187. This fungus was abundant in some parts of the State this year, doing valiant work in helping to destroy a pest in cultivated grounds. In some cases the enlargements of the stem where the oospores are borne in great numbers were many times the normal size. The particular point, however, in mentioning the species here is to announce that the leaves were found distorted, and in these thickened points the oospores abound.

It may be said in closing, that strange distortions of the flower stalks of wild mustard were met with this season, which were due to the growth within of another member of the same genus as above mentioned. It also works striking modifications of the flowers and fruit of the cultivated radish, which are often observed by truckmen who let this plant go to seed.

PREVALENCE OF ERGOT IN 1889.

By Erwin F. Smith.

Claviceps purpurea, (Fr.) Tul. was unusually prevalent along the east shore of Lake Michigan in the summer of 1889. At South Haven and St. Joseph I saw it in every rye-field, and it was so abundant that it could be gathered by the handful. Even scattering patches of rye in orchards, meadows, and along roadsides were infected. The best developed sclerotia were two inches long, but where a half dozen or more grew from one head they were smaller. In that part of the country it has been customary for some years to grow rye in the peach orchards as a green manure. It is sown in the autumn and ploughed down in the spring, but some portion of the crop always escapes the plow and comes to maturity. Moreover, through neglect or for other reasons, the rye is not always turned under green, so that the soil may be

assumed to be infected by sclerotia each year. Another favoring condition was an unusually rainy season, April, May, and June being very wet.

The same month (July) I carefully examined a number of large rye-fields in the central part of the State, where the spring was also wet, but where rye is not commonly cultivated, nor ever twice in succession on the same field, the result being that I could not find a single sclerotium.

It would be interesting to know whether ergot was abundant in other parts of the country, particularly along the Atlantic coast, where the rainfall was very heavy, 1889 being one of the wettest seasons on record.

AN EXPERIMENT IN THE TREATMENT OF BLACK-ROT OF THE GRAPE.

By B. T. Galloway.

Despite the fact that black-rot has ravaged the vineyards of this country for more than a quarter of a century, no systematic attempt, aside from bagging the fruit, was made to combat it until within the past three years. It is true that numerous "remedies" were proposed for the disease, but in no case had any of them stood the test of a thorough trial.

Bagging the fruit as a means of preventing rot first began to be extensively practiced something like ten or a dozen years ago, and there is no doubt that when properly done it is still the safest and most trustworthy means of saving the fruit. The only drawback to bagging is the cost, which must necessarily be considerable, as each bunch, in order to be made secure, is first bagged, then the bag is fastened, and finally, when the fruit is gathered, the bags must be removed. All of this of course consumes time, and time is money in this case as well as in any other. Where a man has a few choice varieties that he wishes to preserve for table use it would probably pay him to bag the fruit; but if he is a large grower, using his crop for wine, the impracticability of such a plan will at once become apparent.

At the time bagging first began to be practiced, grape-growers, as a rule, recognized the fact that black-rot was a fungous disease, due to outside influences, and not brought about by any morbid conditions of the plant. At first it was the practice to put on the bags as soon as the first rot specks appeared; but experience soon demonstrated that to preserve the fruit it was necessary to inclose the clusters shortly after the flowers opened.

In order to settle definitely the cause of rot and if possible to provide a remedy, this Department began an investigation of the subject in 1886. It is not necessary here to go into the details of this work, it being sufficient for our purpose to say that it was proved beyond question that the malady was caused by a parasitic fungus growing within

the tissues of the berry, that this parasite was propagated by minute spores which were at all times present in the vineyard only awaiting suitable conditions of moisture and heat and contact with the growing fruit to cause infection. These facts once demonstrated it was readily understood why bagging prevented the rot, as by that process the spores were simply excluded and infection thereby made impossible. Having reached this stage of the investigation, the question arose as to whether there was not some substance or substances which if applied to the fruit would prevent the spores from germinating or destroy them entirely, thereby preventing infection in practically the same manner as with the bags.

The questions to be considered in this connection were numerous and difficult of solution. It was necessary that the substance employed should not injure the fruit or foliage, that it should be cheap, easily applied, and above all things practicable, and, finally, that it should not render the fruit unfit for eating or wine-making. The good results obtained in treating mildew with the sulphate of copper compounds was a sufficient reason for giving these preparations a thorough trial for black-rot. Accordingly the first systematic experiments, made with a view of determining the value of the copper remedies for the disease, were undertaken in the summer of 1887. The experiments were made over a very wide area, and, while the results were by no means conclusive, they were of such a nature as to warrant a further continuance of the treatment.

In 1888 the experiments were repeated on a more extended scale, and as a result it was demonstrated beyond question that in a favorable or even ordinary season from 40 to 60 per cent. of the crop could be saved from rot. These trials also showed that of all the preparations used the Bordeaux mixture, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water, yielded the best results. It was further demonstrated that the applications to be successful must be applied *early;* in fact this was to be expected from what was already known concerning the proper time for bagging the fruit.

This year among other things we planned an experiment designed to throw some additional light on a number of questions in connection with the treatment of black-rot; chief among them were the following:

(1) A comparison of the actual cost and results of the treatment, using the preparations known as eau celeste, Bordeaux mixture, and the ammoniacal solution of carbonate of copper.

(2) The proper strengths of the preparations, i. e. the strength which would give the best results.

(3) The proper time to apply the remedies.

(4) The effect of winter treatment, *i. e.* spraying the vines before the leaves start.

The vineyard selected for the work was situated near Eastham, Va., and was the property of Mr. A. L. Holladay, who, it is proper to state,

conducted all the experiments from beginning to end. The vineyard, of about 2½ acres, contained something over 1,400 Norton vines, these being in their tenth year. This area was divided into sixteen sections; but as two of these were treated with remedies with which we are not at present concerned, they will be omitted altogether. The fourteen sections were treated as follows:

Section 1.—Bordeaux mixture *a*, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water.

Section 2.—Eau celeste, containing 1 pound of sulphate of copper, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 3.—No treatment.

Section 4.—Bordeaux mixture *b*, containing 4 pounds of sulphate of copper, 2 pounds of lime, and 22 gallons of water.

Section 5.—Eau celeste *b*, containing 2 pounds of sulphate of copper, 2 pounds of carbonate of soda, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 6.—No treatment.

Section 7.—Ammoniacal solution of carbonate of copper, containing carbonate of copper 3 ounces, aqua ammonia 1 quart, water 22 gallons.

Section 8.—Bordeaux mixture *a*, applied in a different part of the vineyard from section 1.

Section 9.—No treatment.

Section 10.—Bordeaux mixture *b*, applied in a part of the vineyard remote from section 4.

Section 11.—Bordeaux mixture *a*, applied some distance from 1 and 8.

Section 12.—Bordeaux mixture *c*, containing copper two pounds, lime 1 pound, water 22 gallons.

Section 13.—Ammoniacal solution of carbonate of copper applied at some distance from section 7.

Section 14.—Bordeaux mixture *d*, containing 3 pounds of sulphate of copper, 1 pound of lime, and 22 gallons of water.

Sections 10 and 11.—Were treated in March with a simple solution of sulphate of copper, 1 pound of the copper to 25 gallons of water.

With the exception of 8 all the sections were sprayed the first time on May 18, the second on June 3, third on July 23, fourth on August 3, and fifth on August 16. Section 8 received its first application on the 6th of June, this being the experiment designed to test the effect of late spraying. On the 1st of October the fruit on all the sections was gathered and carefully weighed, with the following results:

Section.	No. of vines.	Total yield.	Average yield per vine.	Section.	No. of vines.	Total yield.	Average yield per vine.
		Pounds.	*Pounds.*			*Pounds.*	*Pounds.*
1	120	307¾	2.56	8	92	158¼	1.72
2	122	393½	3.22	9	17	17	1
3	20	20	1	10	146	470	3.21
4	163	357¾	2.19	11	165	574	3.48
5	99	236¾	2.39	12	23	52	2.26
6	21	11¾	.56	13	108	159	1.48
7	108	159	1.48	14	114	336	2.94

Now, in regard to the cost, the chemicals were all purchased at wholesale rates, as follows:

Sulphate of copper	per pound	$0.06½
Best lime	per barrel	1.25
Aqua ammonia	per pound	0.05
Carbonate of copper, concentrated solution	per quart	0.16⅔

Using the Japy pump and Vermorel nozzle, it is estimated that the cost of labor in applying the remedies was $2.50 per acre for five applications, or one-half a cent per vine. The number of gallons of the various solutions used per acre was, on an average, 44. Taking these figures as a basis, we have the total cost of treating the various sections as follows:

Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.	Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.
			Cents					*Cents*	
1	120	$1.61	1.3	$6.70	8	92	$1.23	1.3	$6.70
2	122	.95	.8	4.90	9	Proof.	.....	.....	.....
3	Proof.	.....	.....	.....	10	146	1.47	1.0	5.29
4	163	1.71	1.0	5.25	11	165	2.23	1.3	6.70
5	99	1.15	1.2	5.80	12	23	.17	.8	4.00
6	Proof.	.....	.....	.....	13	108	.90	.8	4.00
7	108	.90	.8	4.00	14	114	1.04	.9	4.55

It is seen from the foregoing tables that the largest yield per vine (3.48 pounds) is in section 11, where the Bordeaux mixture, containing 6 pounds of copper and 4 pounds of lime, was used. This section also received the winter treatment. By comparing this yield with that of section 1, where the same mixture was used but the winter treatment omitted, it is seen that there is a gain in favor of the winter-treated section of nearly a pound per vine. Now examine the figures in section 4, treated with the Bordeaux mixture, containing 4 pounds of copper

sulphate and 2 pounds of lime, and it will be seen that the yield per vine is 2.19 pounds. In section 10, treated in exactly the same way, with the addition of one winter spraying with the simple solution of sulphate of copper, the yield is 3.21 pounds, a gain of more than a pound per vine. This certainly indicates that the winter treatment in this case resulted beneficially, but whether the same will hold true everywhere we are not prepared to say. Assuming that it does, however, let us, on the basis of the figures here given, estimate the cost of treating an acre of vines and compare the yield with that of an acre not treated.

Let us suppose that A owns a vineyard of 1 acre and that his neighbor, B, is the possessor of a similar number of vines of the same variety. A treats his vineyard six times, as follows:

March 20, sprayed with a simple solution of sulphate of copper, 1 pound to 25 gallons, at a total cost of 65 cents. May 18, June 7, July 23, August 5, and August 16, sprayed with the Bordeaux mixture, containing 6 pounds of sulphate of copper, 4 pounds of lime to 22 gallons of water, at a total cost of $6.70, which, upon adding the 65 cents for first spraying, becomes $7.35.

B makes no treatment whatever, consequently saves the $7.35. A's vineyard of 500 vines yields 3½ pounds per vine, or 1,750 pounds for the whole, which, at 3 cents per pound, equals $52.50.

B's vineyard yields 500 pounds, or 1 pound per vine, valued at 3 cents per pound, or, for the whole, $15. Summing up the results we have the following:

A.

By treatment of vineyard	$7.35
Yield of grapes, 1,750 pounds, at 3 cents per pound	52.50
Balance	45.15

B.

No treatment.	
Yield of grapes, 500 pounds, at 3 cents per pound	15.00
Difference in favor of A	30.15

Turning again to the table we notice that section 2, treated with eau celeste containing 1 pound of copper sulphate and 1½ pints of ammonia to 22 gallons of water, yielded 3.22 pounds per vine. This is indeed a very good showing, but as this preparation, unless used with extreme caution, is certain to burn the foliage its use can not be advised.

The conclusions which we draw from the foregoing may be briefly summed up as follows:

(1) It pays to treat the vines for black-rot.

(2) The best preventive, all things considered, is the Bordeaux mixture, containing 6 pounds of copper sulphate, 4 pounds of lime to 22 gallons of water.

(3) As the amount of copper in the Bordeaux mixture is decreased its value as a preventive is lessened.

(4) The application of the Bordeaux mixture should in all cases begin early, *i. e.*, about the time the flowers are opening.

(5) Spraying the vines before the leaves start with the simple solution of sulphate of copper is decidedly beneficial.*

ERYSIPHEÆ UPON PHYTOPTUS DISTORTIONS.

By F. W. Anderson and F. D. Kelsey.

Dr. Byron D. Halsted's note on *Sphærotheca* on Phytoptus distortions in the September Journal is interesting, and concludes by asking; "Have other Phytoptus growths been found infested with members of *Erysipheæ?*" So far as observations on the subject go in Montana an affirmative answer might be returned. In the article on Montana *Erysipheæ* in this number of the Journal by one of the writers, mention is made of *Sphærotheca Castagnei*, Lév. on *Shepherdia argentea* (Bull or Buffalo Berry), on *Geranium incisum*, and on *Erigeron Canadense;* also of *Sphærotheca mors-uvæ*, (Schw.) B. & C. on *Ribes rotundifolium;* the former fungus on *Shepherdia* and the latter fungus on *Ribes* were associated with the mites, and the peculiar powdery coating caused by these creatures in places almost covered the fungus. In both cases the distorted leaf axils, abnormally developed buds, and thickened brittle upper leaves bore the perithecia of largest size and in greatest numbers, leading us to the same natural conclusion as was formed in the mind of Dr. Halsted regarding the benefit received by the fungus through the unusual softening of the host tissues. Like him, too, we observed that on those portions of the host unaffected by the mite the fungus was only in an ordinary degree of development for that time of the year [July 10 for *S. Castagnei*, Lév., and June 8, or 9, for *S. mors-uvæ*, (Schw.) B. & C.]

On the *Geranium incisum* occurred also some mite together with the *S. Castagnei*, Lév., and again the fungus seemed to be more richly developed on the doubly affected parts. Late in the season the same fungus was found on *Erigeron Canadense*, and growing side by side with this host were plants of *Epilobium coloratum* badly affected by a mite, and the conidial form of an *Erysipheæ* which seemed to be *Sphærotheca Castagnei*, although no positive determination could be reached. On *Oxytropis Lamberti*, *Astragalus triphyllus*, and *Astragalus adsurgens*, *Erysiphe communis*, (Wallr.) Fr., has been frequently seen in company with a mite; while *Erysiphe cichoracearum*, DC., may be found at almost any time during the summer in connection with mites on *Chrysopsis villosa*, *Helianthus* (several species), *Cnicus undulatus*, *Erigeron macranthus*, and *Mertensia Sibirica*. In every case where these forms of animal

*Applicable only to this experiment.

and vegetable life are so associated there is a more vigorous development and more early maturing of the fungus than under ordinary circumstances. Let us hear from others on this interesting subject.

TREATMENT OF APPLE SCAB.

By B. T. Galloway and E. A. Southworth.

In May of last spring arrangements were made with the experiment stations of Michigan and Wisconsin to carry on a series of experiments for the purpose of finding a remedy for Apple Scab (*Fusicladium dendriticum*, Fckl.).

The fields of experiment were located at Lansing, Mich., on the College Farm, and at Ithaca, Richland County, Wis.; the work at the former place being under the direction of Professor Taft, Horticulturist of the College and Experiment Station, and at the latter under the general supervision of Professor E. S. Goff, Horticulturist of the Wisconsin Experiment Station, and in direct charge of Mr. A. L. Hatch, of Ithaca.

The season was a favorable one, as the weather was wet enough to favor the growth of the fungus and thus offered a fair test of the remedies employed.

The plan of work was drawn up at this Department and the same outline for the experiments was given to both. The instructions were very carefully carried out, and both experimenters have been unremitting in their diligence in making the applications and preserving accurate accounts of the results.

The fungicides used were sulphide of potassium, hyposulphite of soda, a soluble sulphur powder prepared by Mr. E. Bean, Jacksonville, Fla., ammoniacal solution of copper carbonate, and modified eau celeste. Professor Goff, however, did not use the eau celeste.

Both made seven applications; Professor Goff beginning May 18, and Professor Taft May 24, when the apples were about the size of peas and before any trace of scab was apparent. In regard to the time of beginning, Mr. Hatch says he is convinced that the applications should be started earlier, as he thinks fungus activity begins with the swelling of the buds. The varieties treated were the Northern Spy, by Professor Taft, and the Fameuse, by Professor Goff; both selected because they had been particularly troubled by scab previous to the present year.

With regard to the strength of the solutions employed, Professor Taft and Professor Goff both used the potassium sulphide in the proportions of one-half ounce to the gallon of water. The hyposulphite was used in both cases at the rate of 1 pound to 10 gallons. Professor Goff records some injury to the leaves from this strength, and on the fifth applica-

tion Professor Taft reduced the solutions, using 1 pound to 12 gallons, after which he says there was no further injury to the foliage.

The soluble sulphur powder was used in the proportion of 1 pound to 10 gallons of water, but Professor Taft was not able to make the first application until June 6. Mr Bean also sent Professor Goff a concentrated solution of the powder, which was diluted and used for three applications to two trees, after which he was obliged to stop because he had exhausted the supply and received no more.

The copper carbonate was prepared differently by the two. Professor Taft used the usual formula, 3 ounces of copper carbonate dissolved in 1 quart of ammonia and the whole diluted to 22 gallons. It was used at this strength throughout the experiment, but produced a russet appearance on the fruit, and he recommends that it should be diluted to 28 instead of 22 gallons.

Professor Goff procured the copper carbonate by precipitating it with carbonate of soda from a solution of copper sulphate. He found that only $1\frac{1}{8}$ ounces of the dried precipitate would dissolve in 1 quart of ammonia, and to this he added 90 parts water. At the sixth spraying (July 24) he observed that the apples had assumed a russet appearance from some injury to the epidermis. For the sixth and seventh spraying he reduced it one-half, that is diluted it 180 times.

Professor Taft prepared the eau celeste as follows: He dissolved 2 pounds of copper sulphate in hot water, and in another vessel dissolved $2\frac{1}{2}$ pounds carbonate of soda; the two were mixed and diluted to 22 gallons, $1\frac{1}{2}$ pints of ammonia being added before using. This also gave a russet appearance to the fruit, and he recommends the use of 30 or 32 gallons of water instead of 22.

On the sixth application Professor Taft only sprayed one tree with each solution, leaving one unsprayed in each case. He made the last application August 1, and Mr. Hatch made the last application for Professor Goff on August 10.

Results.—The copper solutions remained persistently on the leaves, even resisting heavy showers which washed off all traces of the sulphur compounds, and when the leaves fell in October traces of copper could still be seen on them.

Scab was first noted at Lansing on the fourth application, June 25, when it had made its appearance on all the trees, but was noticeably less on those sprayed with the copper solutions, and less on the other treated trees than on the untreated ones.

At time of harvesting Professor Taft picked all the apples on the trees and assorted them into three lots, of first, second, and third quality. The first class contained those free from scab, the second those slightly scabby but not distorted or under size, the third those that were distorted or under size. Those in each class were counted and the percentage which they formed of the whole estimated.

At Ithaca, Wis., the apples were not all picked, but a market-basket

holding about 1½ pecks was first filled with apples from the lowest branches of one of the trees. Next a similar basketful was picked from the branches that were just the height one could conveniently reach, taking care to pass clear around the tree in both cases. After this a basket of one-half a bushel was filled from the tallest branches of the tree. The apples were then poured upon an assorting table; and the baskets filled and emptied again in the same manner and from the same tree, after which the contents of the six basketfuls were assorted into three qualities as in the preceding case.

The results in both cases are embodied in the following table:

	Professor Goff's experiments.					Professor Taft's experiments.					
	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Total yield.
		Per cent.	*Per cent.*	*Per cent.*	*Cts.*		*Per cent.*	*Per cent.*	*Per cent.*	*Cts.*	*Pounds.*
Potassium sulphide	7	30.04	48.55	21.41	37	7	25.5	74.3	.2	39	1,615¾
Sodium hyposulphite	7	43.24	42.78	13.98	29	7	23.6	75.4	.89	23	1,648
Sulphur powder	7	32.72	54.31	12.97	31	6	17.6	81.2	1.1	31	1,435¾
Am'l copper carbonate	7	75.02	23.35	1.63	38	7	51.2	48.6	.16	49	2,112¾
Eau celeste	.....	.....	.....	.....	.....	7	68.8	31.0	.2	60	1,675¾
Sulphur solution	3	42.9	48.99	8.11	.....	.....	.....	.....	.....	.....	.....
Unsprayed	.....	23.34	53.89	22.71	.....	.....	12.5	85.7	1.8	.....	769¾

It will be seen that at both places there is a very decided showing in favor of the copper solutions. Professor Goff did not try the eau celeste, and this produced the best results for Professor Taft, giving 68.8 per cent. entirely free from scab. One of the trees produced 88 per cent. free from scab, the other was heavily loaded and gave 59 per cent. The two sets of results agree as to the main point but show some striking differences. It is probable that these are partly owing to different localities, varieties treated, and varying conditions of weather, and very likely in great measure to different ideas of the two experimenters as regards the three classes into which the apples were assorted. In many cases it would be a question as to which of two classes an apple should belong.

By comparing the two tables it is evident that the badly scabby apples were more numerous in Mr. Hatch's orchard, while those of the second quality preponderated on the college farm.

Professor Goff obtained the best results with the ammoniacal copper carbonate solution, thereby keeping 75.02 per cent. free from scab against 51.2 per cent. by Professor Taft. There is, however, about the same per cent. of badly scabby apples in both cases. Professor Goff's results with this are even better than Professor Taft's with eau celeste, except that the badly scabby apples were over 1 per cent. greater with the

former. The most striking difference in the results, however, is in case of the sulphur powder. With Professor Goff it ranked ahead of the potassium sulphide, and as regards amount of badly scabby apples, ahead of the sodium hyposulphite, while with Professor Taft it fell behind both. The solution of the powder which was prepared by Mr. Bean, although applied but three times, completely preserved 42.9 per cent. of the fruits from scab against 23.34 per cent. on the unsprayed trees, a very good showing under unfavorable conditions. With Professor Goff sodium hyposulphite succeeded better than potassium sulphide, while the contrary was true with Professor Taft, although the difference is not marked in either case.

Aside, however, from these minor differences, it is evident from the tables that the sprayed trees, especially those sprayed by copper compounds, produced a much larger percentage of healthy fruit than the unsprayed. The greatest difference between the perfect fruit on sprayed and unsprayed trees under Professor Goff's charge was 51.68 per cent. and the least 6.7 per cent. The greatest difference in those under Professor Taft's charge is 56.3 per cent. and the least 5.1 per cent., the two results being essentially the same.

Besides the tabulated results there were others which are of great importance but can not be estimated in exact figures. A scabby apple is much smaller than a healthy one, and in many cases, while the apples could not be placed in class one, the scab had so been held in check that the fruit had obtained a greater size than it otherwise would. Professor Taft gives the difference in weight between perfect and scabby fruits as varying from .037 to .002 pound for each apple, and says the scabby apples are 10 per cent. smaller than the perfect ones, making a difference of nearly a bushel per tree in size alone, besides the fact that the apples that are badly scabby are unmarketable. "From the combined effect of the two causes," he says "we lost on some trees a barrel of apples."

The cost of the chemicals and labor expended varied but slightly in the two cases, but both gentlemen were obliged to buy chemicals in small amounts, and the cost per tree would be greatly lessened by treating a large orchard and buying materials in quantity. Professor Taft used large trees requiring 3 gallons each for each application, while Professor Goff used 3 gallons for the two trees, but Professor Goff estimates the labor higher than Professor Taft, and this makes the figures nearly alike. Both these estimates, however, are for seven applications. In an average season, and with the copper solutions, four or at most five applications will probably be sufficient. It is likely that in a large orchard with average sized trees, when the chemicals were purchased by the quantity the expense could be reduced nearly one-half. The expense of the ammoniacal solution in particular would be reduced by purchasing the copper carbonate instead of preparing it from the sulphate.

everywhere, and we feel sure that we voice the sentiment of all workers in this field when we say that the Kew authorities could not render a better and more highly appreciated service than the carrying out of such an undertaking.

NEW LOCALITIES FOR PERONOSPORA CUBENSIS, B. & C.

In the *Botanical Gazette* for August, 1889, and on page 201 of the present JOURNAL, attention is called to this fungus, the localities for its occurrence being given as Cuba, Japan, and New Jersey. We have recently received it from Anona, Fla., and College Station, Tex. At the former place, according to our correspondent, it appeared in the early part of December and destroyed a large number of cucumber plants growing in the open air in a few days. At College Station it also occurred upon *Cucumis sativa*, but no account of the injury it occasioned was furnished. That it was abundant there, however, is evident from the fact that our correspondent sent us more than 150 good specimens and did not seem to have any trouble in getting them.

REVIEWS OF RECENT LITERATURE.

BEUCKER, GEORGES. *Traitement du Mildiou.* Le Progrès Agricole, 4 août 1889; *ibid.*, 1er septembre 1889.

These short reports coming from the French School of Agriculture recommend strongly to the use of viticulturists a fungicide which has hitherto not been used to any great extent in this country—verdigris, or basic copper acetate. In an experiment extending over three years this fungicide has proved to be, taking all its features into consideration, the most satisfactory among the copper compounds. The chemical itself being a mixture of the normal and bibasic acetates of copper is decomposed by the action of water, and the insoluble bibasic salt precipitated as a light jelly-like substance, which upon being sprayed upon the leaves dries and covers them with a hard horny layer. It is claimed for this solution, made by adding to 6 or 8 gallons of water at the ordinary temperature 2 to 4 pounds of the powdered verdigris and allowing it to stand twenty-four hours before diluting to 22 gallons, that it possesses in a much higher degree than the Bordeaux mixture the quality of adhesiveness, while lacking none of the latter's qualities as a preventive of mildew.

In the report of September the author answers many questions brought out by the former report of August in regard to the nature of the chemical and its proper application, giving in some detail a method for the home production of the basic acetate from the waste *marc*, or pumice of the grape, and small copper plates. The cost of the material is also carefully worked out, calculation being made for labor of

preparation by the home process. The conclusion reached shows a cost of only $2.25 per acre when the verdigris is of home manufacture. The question of danger in its use is answered by reference to analyses made of grapes sprayed with the mixture, showing only an infinitesimal quantity present in the wine, and also to the medical works of Dr. Pécholier and Saint Pierre, which go so far as to say that when taken in small doses the acetate has a decidedly beneficial influence upon the human system.

From the inexpensiveness of the material, 20 to 30 cents per pound, when it is remembered that only 5 to 6 pounds are sufficient to spray one acre, the ease with which it may be prepared and applied and its decided efficiency, evinced by such a series of experiments as are contained in these reports of Mr. George Beucker, it seems worthy at least of a thorough trial among the vineyards of this country.—DAVID G. FAIRCHILD.

DIETEL, DR. PAUL. *Ueber Rostpilze, deren Teleutosporen kurz nach ihrer Reife keimen.* Botanisches Centralblatt, 1889, Nos. 18–20.

Dr. Dietel attacks the well-known Lepto and Micro sections of the genera of the *Uredineæ* and says no such division can be made either on a morphological or biological basis. He cites examples of species belonging to other sections whose teleutospores also germinate immediately after ripening. He recommends instead of the Lepto and Micro sections one section whose distinguishing character should be the formation of teleutospores unaccompanied by any other form, and that this should have two subsections with the same distinguishing characters that now mark the two main ones.

The species belonging to the Lepto-section of the *Uredineæ* are discussed according to their hosts, and in many cases the union of species generally considered as distinct is suggested; among these suggestions are the following:

Puccinia malvastri, Pk., is undoubtedly identical with *P. sherardiana*, Korn., and the latter name, being the older, should be adopted. The group of *Uromyces* attacking the *Malvaceæ* should probably be much reduced in number, but at least one true *Lepto-uromyces* must exist.

Puccinia mesnieriana, Thum. on *Rhamnus alaternus* in Portugal is identical with *P. digitata* on *R. croceus* from California.

P. saxifragæ, Schlectd., *P. curtipes*, Howe, and *P. striata*, Cke., are probably identical, and *P. saxifragæ* is a *Lepto-puccinia.*

P. chrysosplenii, Grev., *P. spreta*, Pk., and *P. congregata*, E. & H. differ only in minor points, so that it is impossible to consider these species with which *P. tiarellæ*, B. & C., and *P. heucheræ*, Sch., should probably be included as strongly distinct from each other.

He considers *P. asteris* as the type of *Puccinia* on *Compositæ* and notes the following as agreeing with it more or less perfectly: *P. vomica*, *P. serratulæ*, *P. subtecta*, *P. Printziæ*, *P. gerardii*, *P. xanthii*, *P. silphii*, and *P. grindeliæ.*

Conclusions.—The presence of *Uredineæ*, whose teleutospores germinate immediately after ripening, is not confined to certain families of Phanerogams, the *Liliaceæ*, *Gramineæ*, *Cyperaceæ*, and *Umbelliferæ* being the only families not represented among their hosts. Their presence does not seem to depend simply on the presence of host plants, but to be correlated with meteorological conditions. They are more abundant in high mountains and moist valleys, or on low land by rivers.—EFFIE A. SOUTHWORTH.

KELLERMAN AND SWINGLE. *Preliminary Report on Smut in Oats.* Bulletin 8. Experiment Station, Kansas State Agricultural College, 1889.

There has long been no doubt that wheat may be infected with smut by dusting the grain with spores, or by sowing it in soil in which the spores already exist. Consequently since the spores can pass uninjured through the intestines of cattle, it becomes a dangerous matter to use manure from stock that have had access to straw of smutted wheat. Since this is true for wheat, the natural inference is that it is also true for oats and barley. This has been questioned, however, and in 1888 in an article, already reviewed in this JOURNAL, Mr. J. L. Jensen gave very conclusive proof that grains still included in the husks at the time of planting could not be infected by spores which came in contact merely with the exterior of the husks, and consequently that spores in the manure or in the soil could have no effect on the amount of smut in the crop.

In the Bulletin above mentioned Professor Kellerman and his assistant, Mr. W. T. Swingle, give a full account of further conclusive experiments in the same direction. They have also included in their experiments a comparison of the value of sulphur and iron compounds against hot water as a dressing for seed grain.

An experiment to artificially infect oats when in blossom failed, but other experiments clearly established that the spores must be in or sticking to the seed when planted. Experiments in planting seed treated in different ways in untreated soil and soil which had been artifically manured, or smutted, or both, gave the following results: Soaking the seed in a solution of iron sulphate (1½ pounds per gallon) did not materially decrease the amount of smut or injure the grain; soaking the seed in copper sulphate solution (4 ounces to 1 gallon) eighteen hours prevented smut but lessened the fertility of the seed; treating seed with hot water (132° F.) for fifteen minutes prevented smut and improved rather than diminished the germinating powers of the seed and vigor of the plants; soil which had been treated with manure and smut the previous August actually gave a less per cent. of smut than untreated soil; soaking the seed eighteen hours in a 5 per cent. solution of concentrated lye prevented smut, but injured the seed; soaking eighteen hours in a 3 per cent. solution of sulphuric acid did not pre-

vent smut, while a 10 per cent. solution prevented smut and greatly injured the seed.

Natural enemies of smut.—Five different natural enemies of smut are described. A white mold, probably some species of *Fusarium*; a black mold, a new species of *Macrosporium*; a bacterial disease; and two smut-eating beetles.

The bulletin also contains a few preliminary notes on stinking smut, announcing that experiments are already under way to determine the comparative value of different fungicides in this case also.—EFFIE A. SOUTHWORTH.

KELSEY, F. D. *Study of Montana Erysipheæ.* Botanical Gazette, Vol. XIV. No. 11, p. 285.

This paper, prepared by Mr. Kelsey, contains a number of interesting notes upon nine species of *Erysipheæ* of Montana, a number of rare hosts being cited, and one provisional new species, *Erysiphe sepulta*, E. & E. on *Bigelovia graveolens*. This species is, however, acknowledged to resemble *E. chicoracearum*, DC. quite closely, a species widely variable upon the many hosts which it inhabits.—DAVID G. FAIRCHILD.

L'ECLUSE, A. DE. *Traitement du Black Rot.* Rapport à M. le Ministre de l'Agriculture. Le Progrès Agricole, October 13, 1889.

The results contained in this short report to the French minister of agriculture, while they present nothing strikingly new in the matter of treatment of black-rot, may be of interest to vine-growers and others as coming from a foreign experimenter. The author theorizes in the first part of the report among other things upon the ability of the fungicidal solutions to penetrate the conceptacles of the black-rot upon the leaves, taking it for granted that the leaf-spot and black-rot of the berries are identical. He believes it consequently almost useless to spray the berries simply without destroying the sources of infection found in the fungus of the leaves, and counsels spraying all the green surfaces of the vine as well as the grape clusters themselves. This to be done at least before the middle of May.

The report of the author's field experiments, in which the common fungicides seem to have been largely used, contains no new points either in matter of apparatus or mixtures, and is somewhat complicated, certain unexpected variations being explained by the ungovernable conditions so abundant in such work. Without discussing the details of the investigations or questioning particularly whether he is authorized in drawing such broad conclusions from only one year's experiments, it may be well to state briefly the author's opinions: That the efficacy of the copper compounds against black-rot is indisputable; that the disrepute into which they have fallen is due solely to misdirected use of them; that their action is at the same time preventive and curative if spread uniformly upon all green parts of the vine; and that the crop

gathered will be lighter as the applications are less perfectly made. In conclusion the writer adds:

I am happy to be able to say that the black-rot, which American viticulturists have considered with reason as the worst of diseases, is to-day a malady less difficult to guard against than the odium, the anthracnose, or the mildew.—DAVID G. FAIRCHILD.

PECK, CHARLES H. *Boleti of the United States.* Bulletin of the New York State Museum, Vol. II, No. 8, September, 1889.

In this bulletin Professor Peck brings together descriptions of all *Boleti* known to occur in the United States. Convenient synoptical tables have been arranged for the use of students, and the author seems to have done everything to make this a complete synopsis of the United States species of this important family. Western readers will at once notice that the Rocky Mountain regions are not cited in the geographical distribution of the species, and even California is only credited with a very few, the vast majority seeming to occur in the Eastern and Southern States. We would naturally inquire whether the *Boleti* have been carefully searched for by botanists in the Rockies, or whether there is a natural but deplorable dearth of such fungi in these regions. It is almost certain that from the western slopes of the Rocky Mountains many new and otherwise interesting *Boleti* will yet be reported, because on the western slopes the best natural conditions obtain for their development. It is possible, however, that the comparative lack of damp forests and copses on the eastern slopes, of the northern Rockies at least, may preclude the possibility of very many *Boleti* ever being found there, as the forests, though extensive, are neither very dense nor very humid.

In the paper before us 110 species are recorded, as against 100 species described in *Hymenomycetes Europæi.* Of the whole number 36 are natives of Europe as well as America. The author has found it necessary to establish two tribes not represented in European *Boleti,* as he remarks, "for the reception of species for which no place is found among the Friesian tribes." He has adopted Fries's classification in the main. He tells us that a few species have been left unclassified in consequence of the imperfect character of their descriptions, and that a few unpublished species have been omitted because they are as yet represented by too scanty material. The genera included in the paper are as follows: BOLETINUS—5 species. This genus is distinguished from *Boletus* by the tubes not being easily separated from the hymenophore and by the hymenium having a perceptibly radiating structure. BOLETUS—103 species; the six following being described as new: *B.* (*Viscipellis*) *hirtellus; B.* (*Subpruinosi*) *dictyocephalus; B.* (*Calopodes*) *rimosellus; B.* (*Calopodes*) *flexuosipes; B.* (*Edules*) *leprosus; B.* (*Luridi*) *subvelutipes.* STROBILOMYCES—2 species. This genus is distinguished from *Boletus* by the tubes being not easily separable from the hymenophore and by the hymenium being without a perceptibly radiating structure. The author remarks that by the former character and by the tough sub-

stance the transition between *Boletus* and *Polyporus* is made. Out of the 110 described, 18 species and 2 varieties are recorded as edible; but of these the three we have marked by Roman type are regarded with suspicion. The edible species are as follows:

Boletus elegans, Schum.; *B. Clintonianus*, Pk.; *B. luteus*, L.; B. granulatus, L.; *B. Collinitus*, Fr.; *B. badius*, Fr.; *B. bovinus*, L.; *B. rubinellus*, Pk.; *B. miniato-olivaceus*, Frost.; *B. miniato-olivaceus*, var. *sensibilis*, Pk.; B. chrysenteron, Fr.; *B. subtomentosus*, L.; *B. edulis*, Bull.; *B. æstivalis*, *B. impolitus*, Fr.; B. versipellis, Fr. *B. scaber*, Fr.; *B. castaneus*, Bull.; *Strobilomyces strobilaceus*, Berk.

Students will not find many *Boleti*, any more than any other kinds of fleshy fungi, during a dry season or during the dry part of any season. They are a moist, fleshy group of plants, and only thrive well where there is plenty of atmospheric humidity. Professor Peck's experience has been that a few common species of *Boleti* may be found from June to October, but that most of them occur only in July and August, the warmest part of the season, and that they are most abundant of all in very warm showery weather.

It was a happy thought which induced the author to prepare this useful monograph; and let us hope that its publication will serve as a stimulus to Rocky Mountain and Pacific coast botanists in the study of the *Boleti* of this vast and too-much neglected region.—F. W. ANDERSON and F. D. KELSEY.

THAXTER, ROLAND. *A New American Phytophthora.* Botanical Gazette, Vol. XIV, No. 11, p. 273.

Dr. Thaxter's note in the last *Gazette* will be of interest to all who know the peculiarities of this somewhat isolated genus. This new species of *Phytophthora* was found in the vicinity of New Haven, Conn., growing upon and destroying large quantities of lima beans. The pods, both young and old, seem to be best suited to the growth of the fungus, upon which it appears as a "clear white felted coating," partly or entirely covering both sides of the pods. Like its near relative, it seems to be a rapid disorganizer, soon opening the way for numerous saprophytic forms. It differs from *P. infestans*, DBy., in its larger and proportionately broader conidia, and the distinct appearance and mode of branching of the conidiophores. In its large size it seems to resemble the *P. cactorum* of Europe, but Dr. Thaxter, although not able to examine specimens of the latter, has decided that it differs specifically from the European species. He has accordingly named it *Phytophthora phaseoli*, n. s., and adds a concise description, which it may be well to repeat:

Mycelial hyphæ branched, rarely penetrating the cells of the host by irregular haustoria. Conidiophores slightly swollen at their point of exit through the stomata, arising singly or one to several in a cluster; simple or once dichotomously branched and once to several times successively inflated below their apices. Conidia oval or

elliptical, with truncate base and papillate apex; 35–50 by 20–24 μ. Germination by zoospores, usually fifteen in number, or rarely by a simple hypha of germination. Oospores unknown. On pods and stems of the lima bean (*Phaseolus lunatus*), New Haven, Conn., September and October.—DAVID G. FAIRCHILD.

THÜMEN, FELIX VON. *Die Pilze des Aprikosenbaumes* (*Armeniaca vulgaris*, Lam.). *Eine Monographie.* Klosterneuburg bei Wien. Verlag der k. k. Versuchs-Station. October, 1888. Small quarto. Paper. pp. 19.

The importance of the apricot industry in some parts of the United States, particularly in California, where there are very extensive orchards, makes this paper of considerable interest to fruit growers.

According to Professor von Thümen the apricot possesses no great longevity, but yields good fruit abundantly and can be grown satisfactorily even upon an inferior sandy soil. Early bearing partly compensates for its brief existence, and but for the number of diseases to which it is subject it would be much more generally cultivated. The author describes twenty-seven fungi which have been found on this tree either as parasites or saprophytes as follows, the former in Italics the latter in Roman type.

ON THE FRUIT.—*Phyllosticta vindobonensis*, Thüm.; *Phoma Armeniacæ*, Thüm.; *Monilia fructigena*, Pers.; *Monilia laxa*, Sacc. & Vogl.; *Glæosporium læticolor*, Berk.; *Epochnium virescens*, Mart.; Sporotrichum lyococcon, Ehrenbg.; Melanomma Minervæ, H. Fab.

ON THE LEAVES.—*Puccinia prunorum* Lk.; *Podosphæra tridactyla*, DBy.; *Capnodium armeniacæ*, Thüm.; *Phyllosticta circumcissa*, Cooke.; *Clasterosporium amygdalearum*, Sacc.; Cladosporium herbarum, Lk.

ON THE BRANCHES AND TWIGS.—Valsa ambiens, Fr.; Valsa cincta, Fr.; Valsa leucostoma, Fr.; Eutypella prunastri, Sacc.; Cenangium prunastri, Fr.; Diplodia pruni, Fuck.; Diplodia amygdali, Cooke & Hark.; Cytispora leucostoma, Sacc. (gonidia of Valsa.); Cytispora cincta, Sacc. (gonidia of Valsa.); Cytispora rubescens, Fr.; *Coryneum Beijerinckii*, Ouds.; Melanconium fusiforme, Sacc.; Hymenula armeniacæ, Schulz & Sacc.

Some of the so-called saprophytic forms may be parasitic. Most of the species occur on other plants. Those peculiar to the apricot are *Phyllosticta vindobonensis*, *P. circumcissa*, *Phoma armeniacæ*, *Epochnium virescens*, *Capnodium armeniacæ*, *Melanconium fusiforme*, and *Hymenula armeniacæ*. It will also be observed that many of these fungi, especially the parasites, are imperfect forms, whose life history remains to be worked out.

The brief Latin description which introduces each species is followed by paragraphs on the characteristics of the disease, its distribution, and other matters of interest, including treatment for the parasites in the few cases where any has been discovered. From these notes it appears that the European *Podosphæra tridactyla* also affects damsons, prunes, and plums, especially the first, but has not been found upon the cherry, although in this country it is common upon the latter. *Monilia laxa* is generally confounded with *M. fructigena*. It

occurs only on plums, prunes and apricots. *Capnodium armeniacæ* is described solely from mycelium and gonidia. *Phyllosticta circumcissa* and *Clasterosporium amygdalearum* make "shot holes" in the leaves. Both are serious evils, the *Phyllosticta* being specially prevalent in the orchards of South Australia. The use of the term perithecia for receptacles containing only gonidia is not to be commended.—ERWIN F. SMITH.

VIALA, PIERRE. *Une Mission Viticole en Amerique.* Published at Montpellier, No. 5 Grand Street, by C. Coulet, and at Paris, No. 120 Boulevard St. Germain, by G. Masson. 1889.

This work (387 pages), illustrated by eight chromo lithographs and a geologic map of the United States, contains the observations upon American grape-vines and their maladies, made by Professor Viala during a tour through the United States in 1887. By the French Government Professor Viala was commissioned to inspect the grape-vines, native of America, which might be found growing in marly or calcareous soils, with the view of finding a species of vine adaptable to culture on similar soils in France. In the preface to his book Professor Viala states that it "is not a report of his work upon this viticultural mission, but rather a study, complete as possible, of all the questions relative to American grape-vines and to the maladies of the vine in the country of their origin." With such a scope, the studies of this distinguished botanist will be of important interest to botanists and viticulturists of America as of Europe. In his extended tour throughout the United States Professor Viala was aided by our Government, and accompanied officially by Prof. F. Lamson Scribner, then Chief of the Section of Vegetable Pathology, United States Department of Agriculture, and now of the Agricultural Experiment Station, Knoxville, Tenn. According to Viala, there are of American vines eighteen known species. In the other parts of the earth there are but twelve; one species in Europe; the others in Asia. *Vitis vinifera* is indigenous to Europe. Of our native vines, those of interest to French viticulture, either as fruit-bearers or as graft-bearers, for the viniferas, are *Vitis Berlandieri*, *V. cordifolia*, *V. rupestris*, *V. riparia*, and sundry varieties of these species.

Of our long list of cultivated varieties but few find favor with Viala, being generally stigmatized as "*foxy.*" This, however, is a matter of national taste. Wines which Frenchmen condemn are approved by Americans and Germans; while Frenchmen long resident with us learn by habitude to prefer the high-flavored American wines. The day may come when the "*peculiar*" flavor of the *Labrusca* and of the *Riparia* may be esteemed as a commendation. "*De gustibus non disputandum.*"

Part second of Viala's volume is devoted to an exhaustive study of "the maladies of the vine in America"—black rot, white rot, bitter rot,

anthracnose, oidium, and other fungi, together with suggestions for their treatment; also a formidable list of insect enemies to the vine and its fruits; and an appendix treating of the adaptation of American vines to soils.

Altogether this work of the distinguished botanist is of standard interest, and in its preface we have the assurance that it will be soon followed by a second volume, wherein Viala will record personal observations made in travel through our country, and also "Studies upon Viticulture and Vinification in the United States." The volume under consideration is of especial interest to scientists; the volume to come will surely be instructive to the practical student of viticulture and viniculture.—A. W. PEARSON.

WAKKER, J. H. Contributions a la pathologie végétale: (1) *La morve des Anémones, produite par le Peziza tuberosa*, Bull.; (2) *Nouvelle recherches sur la gommose des Jacinthes et plantes analogues*; (3) *Les renflements des branches de quelques espèces de Ribes*; reprint from *Archives Néerlandaises*. Tome XXIII, p. 373–400, with 2 plates on Gummosis.

(I.) The author completes some observations on a disease of anemones known as black rot, and due to *Peziza tuberosa*. This fungus occurs principally on *Anemone Coronaria*, its varieties and hybrids, these being the sorts most frequently planted. It has also been observed on *A. ranunculoides* and *A. nemorosa*.

The symptoms of the disease are essentially the same in all the species. The leaves turn brown, wither early, and pull up very readily. The root-stock is the part first attacked and the chief seat of the disease, but the base of the petioles may also become involved. In a normal condition the interior of the root-stock shows the milk-white color of ordinary starch-bearing parenchyma, but under the influence of this fungus it assumes a gray tint, and becomes soft and easy to crush between the fingers. Large mycelial filaments penetrate this soft mass in all directions, passing between the cells and through them. These filaments were traced into the firm tissues of the rhizome. There their very blunt extremities are found only between the cells, the filaments, as in many other cases, growing around and between the cells before determining their destruction.

When the diseased plants are left undisturbed in the earth, the mycelium produces large sclerotia, easily mistaken for the root-stocks of *A. coronaria*, a fact which singularly favors the spread of the fungus.

Toward the end of April these sclerotia begin to produce the ordinary *Peziza* cups. These are a uniform milk and chocolate color, 55 mm long; 3 mm thick; with a disk breadth of 15 mm. Some other measurements are: asci, 190 x 12 μ.; paraphyses, 190 x 2 μ.; spores, 16 x 8 μ. For admirable figures of the *Peziza* form, see Tulasne *S. F. C.* III, Tab. 22, Figs. 1–5.

In the ascus, or in water, the spores send out long tubes within 24 hours, and produce sporidia in 48 hours, after which they perish. These sporidia occur in great numbers (see also Brefeld, IV., Pl. IX, Fig. 16–19), but are functionless. The case is otherwise on nutrient media. The author used a decoction of raisins, solidified by the addition of gelatine and sterilized by discontinuous heat. This substratum is easy to prepare and very suitable for the development of mucedineous facultative parasites. By germinating the ascospores on slides in drops of this gelatine and transferring the mycelium after four days to Van Tieghem cells, the bottoms of which were covered with gelatine, he obtained a most luxuriant growth, but no sclerotia during the whole life of the mycelium, which exceeded three months.

This fungus needs a start before it is strong enough to attack healthy tissues. Infection takes place by means of the mycelium, and hence, except in rare cases, it is possible only through the parts underground. Ascospores sown on fresh cuts of different rhizomes gave no results; but two rhizomes taken from the same pot were quickly infected (in four days) and destroyed with the usual symptoms, by bringing them into contact with some mycelium taken from one of the cell cultures. When the spores find their way into the soil, especially when they lodge on the posterior decaying end of the rhizone, they are undoubtedly in a condition favorable to robust growth, and have an excellent opportunity to attack the plant.

Dr. Wakker discusses the relation of *P. tuberosa* to *P. bulborum*, which attacks hyacinths and related *Liliaceæ* in the same locality. The chief difference lies in the size of most of the organs, those of *P. bulborum* being smaller. The spore measurements, however, are identical, so that he would be inclined to doubt the specific difference were not the conviction universal among horticulturists that the disease never passes from hyacinths to anemones, or inversely.

The ascus form is common in *P. tuberosa*. In the hyacinth disease, and other sclerotial diseases, the *Peziza* cups rarely develop. For this reason, and others, the author inclines to believe that *P. tuberosa* is the species truly indigenous to Central Europe and that *P. sclerotiorum* and *P. bulborum* are derivatives from this original stock, changed conditions having produced slight modifications, forming distinct but very closely related species.

(II.) The author is able to throw some additional light on the gummosis of the hyacinth. He has also discovered gummosis in the tulip and in *Tecophilea cyanocrocus*. A similar degeneration also occurs in *Ixia* bulbs (Dr. Masters) and in *Cyclamen* leaves (Prillieux).

The very small gum pockets in the substance of the inner scales of the hyacinth are pure white, and their walls are still composed of living cells. These pockets are not limited, however, to the youngest scales, but invade even the outermost tunics and are often large, the walls becoming dead and structureless and the gum exuding on the surface of

the bulb in small drops. These superficial drops frequently contain mycelium, but, as in previous examinations, none could be found in any of the closed pockets, even by the most approved and delicate methods of section cutting and staining. A similar examination of tulip bulbs led to the same result. There is also no ground for belief that gummosis is due to the attacks of *Tylenchus*. Although Beyerinck found gummosis to be communicable in the *Amygdalcæ*, the author so far has not been able to produce it artificially in hyacinths. The moistened gum did not increase in quantity, or cause any gummy degeneration of surrounding tissues when put into wounds or on the cut surface of bulbs. From two experiments in which bulbs were kept for a long time in moist earth at a high temperature (30° to 37° C.), and from considerations published elsewhere, the author concludes that the stinking white rot of the bulbs is always preceded by gummosis. In conclusion he says:

The little we know to-day on the subject of gum formation in bulbous plants may be summarized as follows:

(1) The gum is found essentially either between the parenchyma cells of the scales or else between the epidermis and the parenchyma.

(2) In the vicinity of a gum pocket the starch disappears from the parenchyma cells and is replaced by gum.

(3) Those cells totally deprived of starch are not only completely alive, but may increase much in size and even divide tangentially.

(4) In the cells which have died prematurely the starch remains unchanged.

(5) Lining the greater part of the wall of cells, which surrounds the cavity, is a layer of gum of greater density (as shown by its yellow color) than that which occupies the center of the cavity.

(6) Gummosis and the white rot are one and the same disease.

(7) Of a parasitic cause there is no trace.

(III.) The author describes what he calls a *rhizomania* in species of Ribes, *i. e.*, a tendency in the branches to the formation of numerous, incipient, adventitious roots. These abnormal roots either do not pierce the bark or dry up and die as soon as they have done so, leaving only slight conical prominences. The result of these numerous growths is a hypertrophy and degeneration of various tissues, especially of the bark, with the formation of black or brown, rough and irregular, roundish or elongated tumors, having a diameter many times greater than that of the normal branch. Main stems, robust vertical branches, and shoots of the first year show no trace of these tumors, and where only a single root was formed the author observed no pathologic change.

These growths differ from the ordinary production of roots on branches in the following particulars: (1) The disposition of the roots appears to be entirely independent of the force of gravity or the direction of the light. (2) These roots also differ essentially in that their production is not restricted but goes on indefinitely to the formation of tumors. The author has been able to find in literature no mention of any analogous fact. In some respects the growths suggest "witch brooms," but the author could find no traces of any animal or vegetable parasite.—ERWIN F. SMITH.

ZACHAREWICZ, ED. *Traitement de la Maladie des Pommes de Terre, des Tomates et des Melons, par les Sels de Cuivre.* Le Progrès Agricole et Viticole, 14 Juillet, 1889.

The author gives in this brief note a few points of practical value in the treatment of potato and tomato rot, *Phytophthora infestans*, DBy., especially as testing the efficacy of the eau celeste and sulphosteatite, a mixture of one part of powdered copper sulphate to nine of talc, "it being well known that alternate treatments of Bordeaux mixture and this powder have proved generally successful."

For the purpose of experimentation three lots of tomato vines were taken. The plants of the first were grown in hot beds upon trellises and carefully guarded against rapid changes of temperature by raising and lowering the sashes. Those of the second and third lots were grown without any trellises in the open air, exposed to natural conditions. In the first set, guarded from the heavy dews, present in that locality in the month of June, only three sprayings with eau celeste given at intervals of fifteen days, preserved the plants perfectly from the disease. The second, exposed to ordinary climatic conditions, was sprayed upon May 8, and 28, and June 18, with eau celeste, and dusted May 20, June 8, and 26, with the mixture of copper sulphate and talc. By this treatment the disease, which appeared first May 26, was stopped and the fruits completely preserved, while a number of plants to one side, left unsprayed, lost by June 10, not only their leaves, but the greater part of their fruit. The third set, which differed from the second only in that all six sprayings, made about the same time, were with eau celeste, failed to give as satisfactory results, at least one-third of the fruits being destroyed by the rot. This difference in favor of the second lot the author thinks is due to the alternate use of the copper solution and the sulphosteatite, and draws the following conclusions from his experiments: That, the malady having its seat in the organs of the plant, all successful treatment must be preventive, consequently commenced before transplanting and continued at intervals of fifteen to twenty days, care being taken to treat in the intervals with sulphosteatite; that it is best not to modify the formula for eau celeste given by Mr. Audoynaud—1 pound of sulphate of copper in 2 gallons of water and 1½ pints of ammonia, diluted with 22 gallons of water when cool; and that the sulphosteatite should be applied at the rate of 14½ pounds to the acre, preferably early in the morning.—DAVID G. FAIRCHILD.

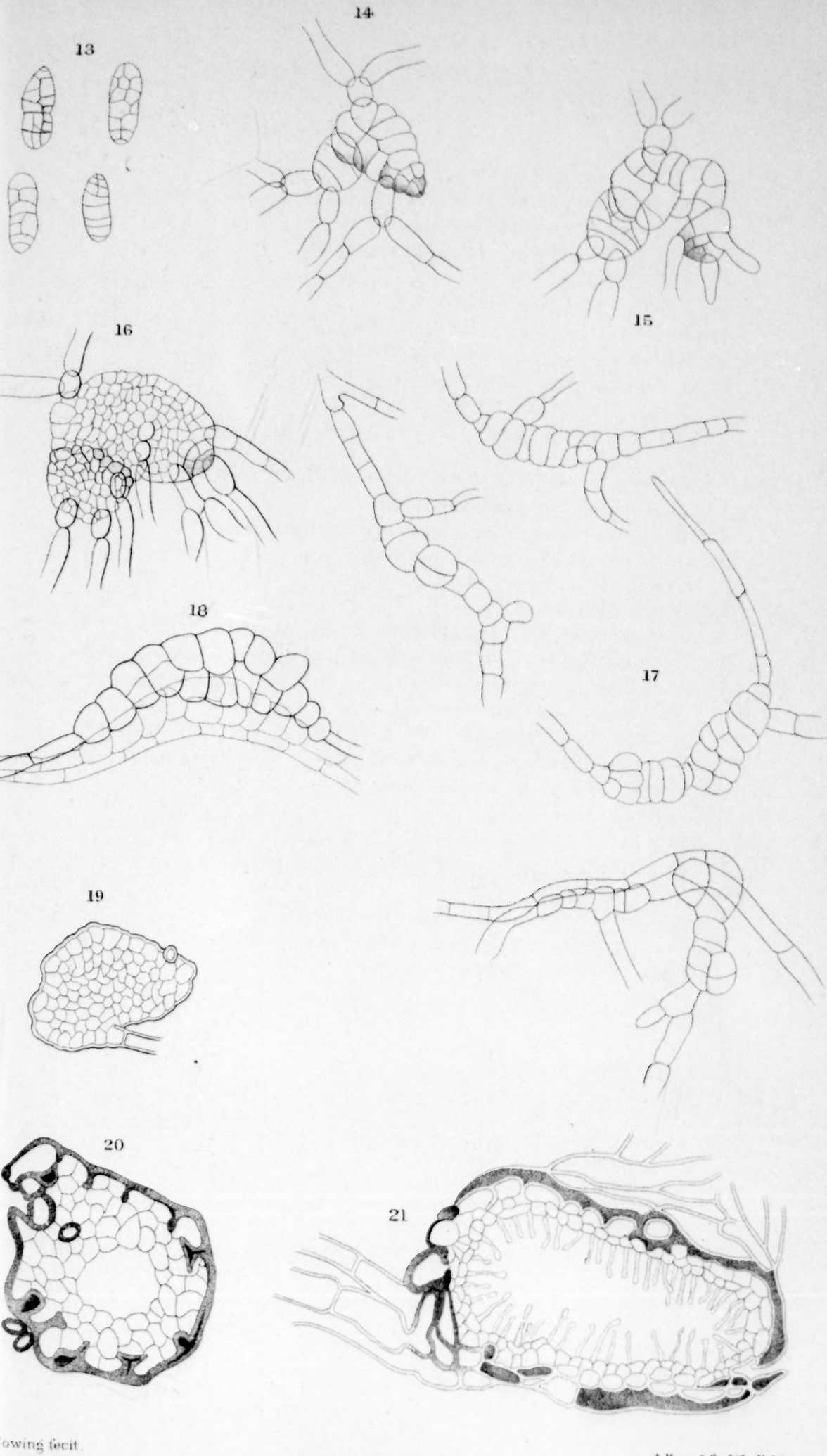
DESCRIPTION OF PLATES.

PLATE XIII (*after Von Tavel.*)

FIG. 13. *Cucurbitaria platani*, Von Tav.; ascospores × 380.
14. Formation of sporopycnidium; the spore three days after sowing. × 380.
15. The same spore five hours later × 380.
16. The same spore twenty hours later × 380.
17. Beginnings of pycnidia × 600.
18. A later stage of the same × 600.
19. Section through a young pycnidium, the cavity not yet formed × 700.
20. Section through an older pycnidium × 700.
21. Section through a fully-formed pycnidium × 700.

PLATE XIV (*G. Massee, del.*)

FIG. 1. *Tremella tremelloides*, (Berk.) Mass., portion of a plant, natural size.
1*a*. Basidia and spores of same × 400.
2. *Stella Americana*, Mass.; specimen natural size.
2*a*. Vertical section of same, natural size; (*a*) outer wall of peridium; (*b*) inner layer.
2*b*. Spores of same × 350.
2*c*. Spore of same, showing epispore, as seen when × 1,200.
3. *Trichosporium Curtisii*, Mass.; portion of a specimen natural size.
4. *Trichosporium phyrrhosporium*, (Berk.) Mass.; (*a*) conidia; (*b*) a condiophore detached from its hypha, all × 350.
5. *Trichosporium apiosporium*, (B. & Br.) Mass.; conidia × 350.
6. *Badhamia nodulosa*, (Cke. & Balf.) Mass.; entire specimens × 40.
6*a*. Portion of capillitium and spores of same × 350.
6*b*. Spore of same × 1200.
7. *Physarum scyphoides*, Cooke and Balf.; specimens × 40.
7*a*. Portion of capillitium and spores of same × 350.
7*b*. Spore of same × 1200.
8. *Tilmadoche gyrocephala*, Rost.; specimen × 40.
8*a*. Portion of capillitium and spores of same × 350.
8*b*. Spore of same × 1200.



Roberta Cowing fecit.

A. Hoen & Co. Lith. Baltimore.

VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.

CUCURBITARIA PLATANI

G. MASSEE, Del.

A. Hoen & Co. Lithocaustic, Baltimore.

MASSEE. MYCOLOGICAL NOTES.

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